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BRIEFLY TOLD.

GAS COMPANIES AND THE FUEL SITUATION.—It is difficult for a gas company to do anything that will meet with the unqualified approval of the public, and where its only claim to this approval is that it has *not* done something, it is still more difficult for it to secure a proper appreciation. The fraternity may congratulate itself that in the trying times we are now passing through, when a little heat is often the price of a life, the gas companies, with few exceptions, have not raised the price of their product. The exceptions mentioned might be almost counted on the fingers of one hand, and the total yearly output of all such companies is considerably less than 100 million cubic feet. Our detractors may say that the companies, by reason of legislative or other restrictions, were unable to raise prices; but many companies were not so situated, and the unanimity with which they maintained existing prices is an assurance that the others would also have done so voluntarily. Gas companies have been generally blamed for "poor" gas and "poor" pressure during the entire Fall. Both of these charges were in the main true, but if the supply (indifferent as it has been) had stopped for a few days or weeks, gas consumers would have had little to say of the quality or pressure when the supply was resumed. Coal supply may fail and electric lights go out, but gas must "go on for ever," and the supply be as sure as death and taxes. It is a fact that many companies had a daily output in September of this year equal to their daily maximum of December of other years. This would mean generally that the companies would be required to furnish a winter maximum about 60 per cent. greater than ever before. Few companies are capable of responding to such a demand, or would be justified in making the expenditures necessary to prepare themselves for it. To maintain a supply the pressures have been reduced, which, to the average consumer, means "poor gas." To intensify the situation the quality was also bad. The prices of all materials used in gas manufacture have increased enormously, and particularly in water gas manufacture. Naphtha rose in a few weeks over 100 per cent., and hard coal and coke generally in greater proportion, and as prices increased the quality deteriorated from 25 to 30 per cent. In addition to this it was almost impossible to obtain some of these materials at any price, and many times the companies could not see 24 hours ahead with any assurance of continuing the supply. For many reasons the price of coke has not been maintained as uniformly as that of gas. The policy of storing coke in summer for sale in winter having been generally abandoned as unprofitable, its price has always varied with the demand and seasons. In New York where the quantity manufactured is limited its price has always been high and for more than a year past has been over $6 per ton. Coke is sold by the gas companies in New York and many other cities to contractors, who fix their own price at which it shall be retailed, and the gas companies are not responsible. Outside of these cities I know of no company having charged "over" 20 cents a bushel, but perhaps higher prices have prevailed in some cities. On the other hand, there are cases where gas companies have paid nearly twice this price for retort oven coke for use in water gas plants. As a rule, all companies sold their coke during the time of greatest demand only in small quantities to any one consumer, so that it should benefit the greatest number, and at least one company gave up its entire breeze pile, of some hundreds of tons, to be devoured by an army of human locusts. The epigram of the manager, "Our contribution to Mr. Mitchell's foolishness," while gazing at this pitiful scene, is worthy of record. The action of this company was prompted entirely by human kindliness, but was also unintentionally the most diplomatic thing it could have done. In this particular city whole car loads of coal were spirited away from the freight yards and trees in private grounds cut down for fuel in a single night. The gas company's coal and coke piles were in full view of everyone, and the necessities of the people were such that a few more days of cold weather and short supply of coal would have precipitated an uprising and riot that could not fail to lead to serious consequences. The conditions in

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this city did not materially differ from those in other Eastern cities. It is not the intention to discuss here the causes leading to the coal strike or those responsible for it. They sowed the wind and came perilously near reaping the whirlwind. At this season of casting up accounts for the year with conscience, gas men may congratulate themselves generally that, as regards the coal strike, their balance is on the right side, and though they do not generally "bind their bible with their ledger," they have in this instance put out the best advertisement of gas stoves and heaters that has ever been devised. Whether the relations between the coal men and their consciences are equally satisfactory I do not know; but "I am harassed with doubts."—P.

NOTES.—

THE authorities of Canon City, Col., have granted to Mr. H. A. Black, of Pueblo, Col., the right to there construct and operate a gas plant. Work on construction account will likely not be commenced before next spring.

THE proprietors of the Willimantic (Conn.) Gas and Electric Company have notified the General Assembly that they will petition it for the right to increase the bonded indebtedness to $300,000, and for authority to issue promissory notes for temporary purposes. The Company's present issues on capital account are: Bonds, $200,000; stock, $200,000.

THE owners of the Coatesville (Pa.) Gas Company have issued notice that, on the 20th prox., they will apply to the Governor for a charter for the Coatesville Gas and Power Company, with the right to conduct business in the adjoining townships of Valley, East Fallowfield and Cain.

ON the 12th prox., Messrs. F. J. Cully, Norman H. Moyer, J. B. Alderfer, Thos. E. Sauter and H. R. Moyer will apply to the Governor of Pennsylvania for a charter for the Perkiomen Gas Company, which is to manufacture and distribute gas in certain named towns in the Perkiomen Valley, prominent among which are East Greenville, Pennsburg, Collegeville and Green Lane.

THE new plant of the Milwaukee (Wis.) Gas Light Company will be in readiness to send out gas next fall.

Gas Engines and Peat Fuel.

Electricity, in recent editorial mention of this subject, says that if the peat bogs of Ireland could be turned to good account the future of that unfortunate country would be far brighter, considered from an industrial point of view. The matter is regarded as of great promise and enormous importance, therefore it is not at all surprising that the Chairman of the Dublin section of the Institution of Electrical Engineers should select it as one of the chief points in his presidential address. The indifference of the gas engine to the class of food it gets was mentioned as one of its remarkable qualities. Its capability of using poor gas was stated by Mr. A. E. Porte, to point to it as the heat motor best adapted to obtaining power from the product of the Irish peat bogs, and yet those interested in the development of the peat industry had paid very little attention indeed to it. It is, however, nearly 20 years ago that the Royal Dublin Society appointed a committee to investigate peat fuel, with the result that a Siemens regenerative furnace was built at Inchicore for working up scrap iron, and this was fired with producer gas made from peat.

The peat used contained from 38 per cent. to 40 per cent. of moisture, and no difficulty was experienced in maintaining the temperature of the furnace. The average consumption was 5.09 tons of peat per ton of iron forged from scrap to finished work; 3 tons of coal would have been used under similar conditions, and 4.96 tons of the coal were used in an ordinary furnace. Mr. Porte thinks it possible that by the Mond process the ammonia might be recovered from peat. The evaporation of the moisture contained in peat amounts to some 15 per cent. to 20 per cent. in air dried peat, and this is one great drawback to its use as an ordinary fuel, it absorbs so much of the heat of combustion; but in a producer this evaporation is carried out by heat in the gases, the loss of which is almost inseparable from the operation of a producer.

Jebsen claims for his process of manufacturing peat fuel in electrically heated retorts, that it has a remarkably high efficiency; the peat charcoal produced is said to have a S-g 0.3, and a theoretical calorific value of 7,000 B.T.U. The analysis is stated as follows: Carbon 76 9; H, 4.64; O, 8.15; N, 1.78; S, 0.70; ash 3; moisture 4.82 per cent. during distillation. The gas given off is treated in the usual way, and the tar and water collected, the proportions being; peat fuel, 33 per cent., tar, 4 per cent., tar water, 40 per cent., and gas 23 per cent.

[Concluded from Page 906.]

The Future of Coal Gas and Allied Illuminants—No. II.

[The second of a series of Cantor Lectures, delivered before the Society of Arts, London, England, by PROF. VIVIAN B. LEWES.]

In order to show the greatest gain from the process, the water gas would have to be brought in a pipe through the retort itself, so as to be heated to the same temperature as the retort. It should then be discharged into the body of the coal, so as not only to hurry the gas out of the retort, but also out of the coke. To do this in a practical way, so as not to interfere with the charging and drawing of the retort is, I admit, an engineering difficulty. But I think if the value of the process was realized it would soon be found possible, with horizontal retorts, to have the water gas tube, perforated at intervals, fixed on the bottom of the retort, and to slide in the charge of coal in a sheet iron tray loosely fitting the retort, and with a perforated and recessed ridge in its lower portion, which would slide over the water gas supply pipe, whilst the coke would be withdrawn in the tray when carbonization was completed, and a fresh tray slid in its place. In this way the water gas would be heated in the pipe and would pass through the charge, washing out the escaping gas, and giving a further gain. I fear, however, that the water gas itself would under these conditions attack an iron tube, and that a porcelain or fireclay tube would have to be used.

The process has been tried at Remscheid, in Germany, and has given results of the same character as those recorded here, whilst stopped ascension pipes, which were a constant trouble with the class of coal used there, have been reduced to one-third the previous number.

There is one point which must be clearly borne in mind by the gas manager in considering the economic use of water gas in the dilution of coal gas and the distillation of coal, and that is that the output of the works must be large enough to keep the water gas generator continuously working, as it is only under these conditions that the expenses can be reduced to a minimum. While it is perfectly possible to make water gas by the Dellwik process at a little over 3d. per 1,000, when the plant is being worked to its full capacity, the price will naturally increase where the size of the works only demands its being used for a few hours a day. In large works blue water gas will in the future be an absolute necessity, but in the hundreds of small works that supply our country towns the benefits to be derived from its use are minimized to an almost vanishing point by the extra cost of production of a comparatively small quantity of gas.

I have during the last 10 years given a large amount of time to the question of how best to supply small works with an ally which shall prove of as much value to them as the Dellwik plant will to their larger brethren. Mr. Tully, of Sligo, some two or three years ago had a long conversation with me on the subject, and, acting upon the suggestions which I have made to him from time to time, he has perfected an apparatus which should be of the greatest possible value where the gas supply is only of moderate dimensions. At the present time the recovery of benzol from the coke ovens on the Continent has so increased the output of that material that tar, which used to be the only practical source from which it could be obtained, has fallen in price until many works would be glad to dispose of all they produce at 1d. per gallon. Indeed, in many cases it is being used as a fuel in the works; and the only way in which the price of small quantities of tar can be kept up for special purposes is by reducing as far as possible the amount for sale.

The lines on which Mr. Tully has been working have been to take my idea of decomposing hydrocarbons, such as heavy oils, in the fierce heat of the fuel of the water gas generator itself, instead of in cracking chambers, as is usually done in making carburetted water gas, a process which demands a not too heavy grade of oil, and adapt it to the decomposition of tar, so regulating the temperature and the volume of tar that the latter is completely decomposed to carbon, methane and hydrogen, together with small traces of more valuable illuminating hydrocarbons, and then to filter off the finely divided carbon produced by passage through the coke which is afterwards to feed the generator.

The apparatus which he has designed for this purpose consists of an iron shell lined with firebrick and provided at the bottom with clinkering doors. The fuel used in it is, under ordinary circumstances, coke, although, of course, anthracite, or even a certain proportion of bituminous coal mixed with coke, may occasionally be employed. The fuel, after ignition, is raised to incandescence by air blasts from jets arranged close to the bottom of the generator. These air injectors carry in their interior the steam pipes, so that when the necessary degree of incandescence has been reached, steam can be directed on the hottest part of the fuel. In the generator lining, about midway, is a

flue provided with openings into the generator. The flue passes entirely round the generator, and has its exit into a stack pipe closed at the top by a snift valve. The top of the generator has another exit leading into the upper part of the stack pipe. In this way, during the blow the products of combustion are led away through the openings into the flue, insuring a bed of incandescent fuel of constant height; and at the same time, when steam is turned on, the resulting gases can be drawn off through either of the exits. Between the flue and the floor of the generator is a constriction, in the spaces below which are arranged the injectors by means of which the tar is driven in by steam pressure.

In actual working the fuel in the lower part of the generator is first raised to incandescence by the air blasts, and the products, consisting of little else but carbon dioxide and nitrogen, escape into the air through the flue, the snift valve being left open. When the desired temperature has been attained the snift valve is closed, and tar or other heavy hydrocarbons are injected by steam into the annular space below the constriction. Rising through the incandescent fuel, both the hydrocarbon and the steam are decomposed, the former into soot and gaseous products, whilst the latter yields water gas. During this time some steam is injected through the pipes in the interior of the air jets, by which means the clinker is broken up and more water gas formed. The mixed gases then pass upwards with the finely divided carbon from the decomposition, and this latter is removed by passing through the fuel in the upper part of the generator; and being brought down as the red hot fuel sinks it reaches the zone of action, where it is at once utilized for decomposing the steam before the larger masses of fuel are acted on, on account of its finely divided condition. The gases, consisting of a mixture of hydrogen, methane and carbon monoxide, pass away through the stack pipe by a cross pipe, which is fitted with a valve, by which it is closed during the blow.

The results obtained are that for, a consumption of 28 pounds of tar and 20 pounds of coke, 1,000 cubic feet of a 10 to 12-candle gas can be obtained, having the composition:

Hydrogen	64.4
Methane	12.0
Unsaturated hydrocarbons	3.0
Carbon monoxide	15.0
Nitrogen and carbon dioxide	5.6
	100.0
Calorific value	400 B.T.U.'s.

The small coke consumption, due to the bulk of the water gas being made from the carbon of the tar, reduces the price of the gas. Mr. Tully estimates that it costs 6d. per 1,000 cubic feet. It is quite clear that such an apparatus, using up the surplus tar and coke in a small works, would be a valuable adjunct.

From this rapid review of the processes which are available for increasing the volume of gas obtainable from coal, so as to most economically obtain a large volume of a good quality heating gas, and at the same time utilize to the full the illuminating value of such hydrocarbons as can be obtained from coal, it is clear that considerable economies can be effected. In a large works where the blue water gas could be made at 4½d. to 5d. per 1,000 cubic feet it would be possible to put a 14-candle gas, with a calorific value of 500 B.T.U.'s, or a little over, into the holder at a cost of not much more than 9d. per 1,000, as against 1s. per 1,000, which we may take it now costs in large works to make a 16-candle power gas in the holder; so that an economy of about 2½d. per 1,000 would be arrived at in this way. But whilst strongly urging the importance of reducing the sale price of the gas to the consumer to the lowest possible point, it cannot be too strongly insisted upon that the main cost of the gas is not to be found in the retort house. Therefore the economy to be effected can only be but limited. The chief items which swell the cost of the coal gas to the consumer are charges on the enormous amount of capital sunk in mains and plant and the distributing charges, which cannot be avoided.

In considering the question of the illuminating value and the calorific value of the gas, it must be apparent to everyone who has studied the question that no definite relation can exist between them. You may take a dozen samples of illuminating gas of the same candle power, each of which will differ from the others in its composition, and as the calorific value is entirely dependent on the composition, you will often find two 16-candle gases varying in calorific value to a greater extent than do a 16 and a 15-candle power gas more nearly equal in composition. The following table, however, gives a good idea of the general run of values:

Illuminating Value and Calorific Value.

Illuminating Value obtained by Burning to a 16-Candle Flame and Correcting to 5 Cubic Feet Consumption.	Calorific Value. Calories Per Cubic Foot.		B.T.U.'s Per Cubic Foot.	
	Gross.	Net	Gross.	Net.
11.8	129.6	115.7	518.4	462.8
12.0	129.1	116.7	516.4	466.8
12.0	136.8	123.2	547.2	492.8
12.4	134.2	120.4	536.8	481.6
12.8	135.6	122.8	542.4	491.2
14.0	136.1	121.8	544.4	487.2
14.6	150.9	135.3	603.6	541.2
15.1	149.9	134.6	599.6	538.4
15.3	154.4	138.9	617.6	575.6
15.3	158.0	142.0	632.0	568.0
16.0	158.0	142.6	632.0	570.4
16.0	159.9	143.8	639.6	573.2
16.1	158.3	142.1	633.2	568 4
16.8	160.6	144.7	642.4	578.8
16.8	167.6	151.0	670.4	604.0
17.0	163.6	147.0	654.4	588.0
17.4	162.6	146.1	650.4	584.4
17.2	168.2	151.6	672.8	616.4
17.6	172.0	155.3	688.0	621.2

One of the most important points that has to be definitely settled is the method which shall be adopted in testing the illuminating value of low grade gas, *i.e.*, gas having an illuminating value of from 15 to 10 candles. The Gas Referees have provided a well-nigh perfect photometric method for testing gas of an illuminating value of 16 candles, and one which gives satisfaction alike to the gas companies and the authorities, whose duty it is to see that the gas companies fulfill their parliamentary obligations. But with reduction in the standard of illuminating power the London Argand, which is the standard burner for the consumption of 16-candle power gas, must, in order to develop the proper illumination from the lower value of gas, be used under the conditions for which it was constructed, as otherwise a grave injustice is done to the gas, and friction is sure to arise.

It is clearly recognized by everyone who has had practical experience in the testing of burners that the chief factor in developing the true illuminating power of the gas is that the air supply, whilst sufficient to prevent the escape of any unburnt gas or products, should not be fed to the flame in too large a proportion, as otherwise combustion is completed before the separation with incandescence of some of the carbon particles has had time to add its quota of luminosity to the flame, and the illuminating power is in consequence reduced. Now, the London Argand was devised by Mr. William Sugg to develop the maximum luminosity supposed to be possible from a gas of between 16 and 17-candle power, and the air supply to the flame, as regulated by the openings at the bottom of the burner, was so adjusted as to give just the necessary amount of air for this quality. As any fall in candle power means a reduction in the quantity of air necessary for the development of the maximum amount of light, a fall in candle power to 15.5 candles causes an over-aeration, and so accentuates the loss of illuminating value. This was recognized by the Gas Referees, who, in introducing the table photometer, altered the rate at which the gas was burnt at the standard burner from 5 cubic feet per hour to such a rate as will give a light of 16 candles. The recorded illuminating value is then calculated from the rate of combustion; so that if a gas of less than 16-candle value were burnt, the increased quantity of gas consumed should balance the excess of air supplied to the burner.

I have made many experiments to determine the influence of the various ways in which the standard London Argand could be used in testing illuminating value. For all practical purposes these are four in number.

(1.) To burn the gas, as in the old methods of photometry, at a fixed rate of 5 cubic feet per hour.

(2.) To supply gas to the burner until the flame has a value of 16 candles, and then to take the rate of flow necessary to produce this light and calculate back what the illuminating value of 5 cubic feet would be.

(3.)To burn the flame at a fixed height of 3 inches, which is the size of flame given by a 16-candle coal gas burning at the rate of 5 cubic feet per hour, and arrive at the true illuminating value of the gas from the consumption, as in the second method.

(4.) To burn the gas at a 16-candle rate, but to fix the burner in a position which would make the light on the photoped equal to 14 candles or to any other number of candles that may be prescribed.

I used to be strongly of opinion that the right way to utilize the London Argand was always to burn the gas at such a rate as would give a flame of 3 inches in height, as under those conditions you have the air

supplied to the burner exactly fulfilling its normal functions; the height of the flame being an indication of the distance which the combustible gases have to travel before they can obtain the volume of air needed for combustion. Many experiments made during the last 20 years have all indicated that by using the burner in this way the candle power of gases varying from from 25 to 12 candles can be satisfactorily determined.

There is one trouble, however, in using this method in practice, and it is that it is very difficult to get an exact determination of the height of the flame. But I have found, by a long and very carefully carried out series of experiments, that between 17 and 12 candles, the results given by burning the gas to give a flame equal to 16 candles are in such close agreement with those given by burning it with a 3-inch flame that for experimental purposes they are identical, and inasmuch as burning it at the 16-candle rate enables one to use the table photometer, as constructed for 16-candle gas testing, it is manifestly better to adopt a system which requires no alteration in the methods prescribed by the Referees.

This being so, we can now discuss the relative merits or demerits of testing the gas by consuming it at a 5 cubic feet rate and at the 16-candle rate with correction back for differences in consumption. The fact that these two methods give very divergent results directly the illuminating power falls to 15½ is well known, and I think the following experiments show the reason of this divergence. Taking analyses of a 16 and a 14-candle gas made during these experiments the figures are:

	16-Candle Gas.	14-Candle Gas.
Hydrogen	52.62	56.95
Methane	36.10	29.05
Ethylene	3.07	4.00
Benzene	1.00	0.50
Carbon monoxide	5.52	7.50
Nitrogen	1.69	2.00
	100.00	100.00
	Cubic Feet.	Cubic Feet.
Air needed for complete combustion of 5 cubic feet	29.49	26.5

As the air ways of the London Argand are constructed on the basis that 5 cubic feet of 16-candle gas requre for their combustion 30 cubic feet of air, it is manifest that with a 14-candle gas of such composition burnt at the rate of 5 cubic feet per hour, 13 per cent. more air than is needed will be supplied to the flame. The result is at once apparent when the gas is tested for illuminating value at the 5 cubic feet rate:

Gas Tested at 16-Candle Rate.	Gas Tested at 5 Cubic Feet Rate.
14.0	11.5

a difference of about 18 per cent.

In this case the rate of flow had to be increased from 5 cubic feet to 5.7 cubic feet to obtain the 16-candle power flame, an increase in gas of 14 per cent., which, by utilizing the excess of air to the best advantage, brings the illuminating value to the standard which would have been given by a burner specially constructed for its combustion. The wide divergence in the illuminating value ascribed to the flame of gaseous mixtures of varying quality is shown in the following table:

Illuminating Power 5 Cubic Feet Rate, Corrected. Candles.	16-Candle Flame Corrected to 5 Cubic Feet Rate. Candles.	Volume of Gas Required to Yield 16-Candle Flame. Cubic Feet. —
6.7	11.3	7.03
7.8	12.3	6.34
7.9	12.0	6.66
8.0	12.4	6.45
8.2	12.4	6.45
9.7	12.8	6.25
10.7	13.5	5.92
11.5	14.0	5.71
12.3	14.6	5.48
13.5	15.1	5.30
13.7	15.3	5.23
14.2	15.3	5 23
14.3	15.2	5.26
15.5	16.0	5.00
15.6	16.1	4.97
15.6	15.7	5.09
15.9	15.9	5.03
16.2	16.4	4.87
16.8	16.8	4.76
17.0	17.0	4.70
17.5	17.4	4.60
17.7	17.6	4.54

It is seen from this table that for values between 17 and 15.9 candles it is immaterial, as regards results, whether the gas be tested at the 5 cubic feet rate, at a 16-candle flame, or a 3-inch flame, the value recorded being the same in each case. But directly the illuminating value falls below the lower limit, the 5 cubic feet rate of consumption at once begins to record an ever increasing falling off in value, as compared with that shown by the 16-candle flame standard, this being due to improper regulation of the air supply to the burner when the lower qualities of gas come to be burnt at the 5 cubic feet rate.

The only objection to burning the gas at a 16-candle rate and fixing the burner so much further from the photoped as to throw a light on it of 14 candles is that it seems unnecessary when the one correction will do all that is required.

The one point which is essential in using the London Argand is that it should be used under the conditions for which it was made, and that is with a 16 candle power flame, or a flame 3 inches in height. The duty of prescribing what shall be the standard burner rests with the Gas Referees, and they being gentlemen of the highest scientific attainments and capability, the matter can be left entirely in their hands. But I should imagine that, in view of the divided opinion which exists as to the fitness of the London Argand as a standard burner for qualities of gas below 16 candles, and the question that arises as to the way in which that gas should be burnt, they will in all probability prescribe another form of burner better adapted for the quality of the gas that is to be tested.

It is always of interest in a case of this kind to note the causes that led to the adoption of the existing standard and the intentions of Parliament in forming the statutes which refer to it. The holding of the scales of justice between the gas consmmer and the gas companies had its origin, like many other good works, with the corporation of the city of London, as it was their special Act (The City of London Gas Act of 1868) that created Gas Referees and a Chief Gas Examiner for the metropolis; and in procuring that Act their whole desire was to obtain absolute fairness both to the manufacturer and the public.

In the various discussions taking place in the committees of the corporation on the subject of gas supply prior to the passing of this Act is to be found the history of the introduction of the London Argand as the standard burner. It was in December, 1864, that my predecessor, Dr. Letheby, made a report on the gas supply of the city of London to the special committee appointed to consider the question, and from that report I take the following paragraph:

Since the month of February of this year, the gas of all the companies has been tested with a burner which raises the illuminating power about 12 per cent. over that of the old burner. The construction of the burner is strictly in accordance with the provisions of the Act of Parliament, and your officer has adopted it, after much consideration, because he has felt, although the change from the old burner to the new is seemingly against the interest of the public, yet if any question were to arise in a court of law concerning the defective power of the gas, it would, undoubtedly, be said by the companies that justice had not been done to them in the manner of testing; for, as no burner can *produce* light, but merely *educe* it, they are entitled to all the light that can be evoked from the gas by any burner which fulfils the conditions of the Act of Parliament.

It was in view of this, when the 1868 Act was passed and the Gas Referees were created and their powers defined, that their clear duty with regard to the burner to be used for testing was laid down in paragraph 43:

The Gas Referees shall prescribe the burner for testing the illuminating power of the gas, and it shall be such as shall be the most suitable for obtaining from the gas the greatest amouut of light, and be practicable for use by the consumer.

It is abundantly clear from this that the London Argand was made the testing burner because it was the burner which did fullest justice to the gas at that period, and was at the same time one which the gas consumer could utilize if he thought fit. The conditions under which gas is consumed for developing illuminating power are now better understood, and the Gas Referees would manifestly be quite within their powers, in the case of new Acts lowering the candle power of the gas below 16 candles, in prescribing a different standard burner.

It is perfectly well known that the poorer the quality of the gas the lower must be the pressure at which it is supplied to the flame, and the thicker must be the layer of gas presented to the air, the air at the same time supplied to the flame being, in the case of the Argand burner, reduced in quantity so as not to over-burn the hydrocarbons. The form of Argand burner made by Mr. Sugg, and known as the "Wandsworth" Argand, is one which undoubtedly fulfils these requirements. It is a 15-hole Argand, in which trapezoidal instead of circular holes are employed for the admission of the gas, and in which the pressure is reduced from about 3-10ths, as used with the London Argand, to a little over 1-10th, whilst the air supplied to the center of the flame is reduced to the

required amount by the introduction of a rod which contracts the area of the central passage.

I have made a long series of experiments with various qualities of gas with the Wandsworth Argand and the London Argand, and find that when the London Argand, supplied with gas at a rate to yield a 16-candle flame, shows, on correction for flow of gas, that the illuminating value is between 13.5 and 14.5, the Wandsworth Argand gives the same results with gas consumed at the 5 cubic feet rate; but directly the gas becomes poorer than 13.5 candles the Wandsworth Argand at the 5 cubic foot rate begins to show the same destruction of illuminating value that the London Argand, used at the 5 cubic feet rate, does below 15.5 candles.

If the supply of a low grade gas of the character demanded by the needs of the future is to bear its proper economical value to the consumer, it is clear that in defining the quality of the gas a new burner of this description must be adopted for each quality of gas if the 5 cubic feet rate is to be retained; and if it is desired to keep the London Argand as a monument in memory of the past it must be used in such a way as to do the fullest justice that it can to the gas. But I also think that the time has now arrived when in devising the parliamentary requirements a standard of calorific value should also be introduced.

Blast Furnace Gas Engines and Their Work.—No. III.[1]

The Cockerill Engine.—It may be remembered that the Cockerill engine was first operated without cleaning the blast furnace gas. This led to a number of difficulties, the cylinder surface particularly being worn seriously. Now that adequate cleaning of the gas is general it is hoped that this exceptional wear will be removed. Aside from this trouble and from the difficulties incident to the first introduction of such matters the Cockerill engine has proven to be a reliable machine in practice. This is all the more remarkable since from the outstart and until recently the Cockerill gas engine had the largest units per cylinder, about 600-horse power. The apparent durability of the Cockerill cylinder head may be explained from the fact that the engine works with moderate compression and, therefore, under low temperatures. This is confirmed by a statement made by the firm that the consumption of cooling water per hour of horse power is larger than it is with other designs, being 80 liters warmed from 15° to 40° C. The cooling water, therefore, carries off 80 by 25, equal to 2,000 calories per hour per horse power, while this figure is reported to be by other firms 1,000 to 1,200 calories. The construction of the cylinder head appears to me to possess several advantages. Placed below is a water cooled exhaust valve and inlet valve, which also serves as a mixing valve, and in front of them in the cold part of the cylinder head there is an air and a gas valve. With this arrangement the connections between the inner and the outer wall, which transmit the expansion strains and which hinder the water circulation, are reduced to a minimum, and in this way a very effective cooling may certainly be carried through. Besides this the design of cylinder head used thus far possesses the peculiarity as compared with others that the flange for securing it to the cylinder jacket is very widely drawn forward. Therefore it is not exposed to the highest temperatures and the connection of the jacket to this flange is sounder. With this design of cylinder head the inner and the outer walls between the inlet and the exhaust valves alone can cause difficulties. It is true that it must be regarded as a drawback of the former Cockerill design that the cylinder is cast in one piece with the cylinder head, so that a defect in one leads to the replacement of both.

The governing of the Cockerill engines thus far built was arranged by means of an adjustable air governor and is adequate for blowing engines and for direct current dynamos. For alternating current dynamos, however, it will probably prove unsuitable. Therefore, in the latest designs Cockerill has introduced a new governor, shown in Figs. 8 and 9.

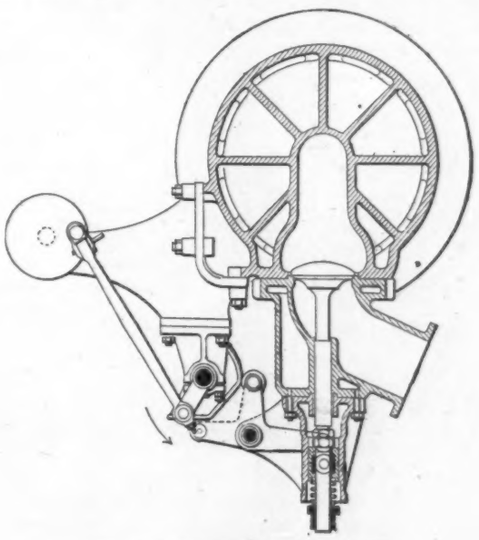


Fig. 9.—The New Cockerill Exhaust Valve.

Like most of the modern governors, this depends upon regulating the quantity with variable compression in such manner that the special air and gas valves of former designs are omitted and that the spindle of the inlet valve is guided by the hollow spindle of a second smaller valve.

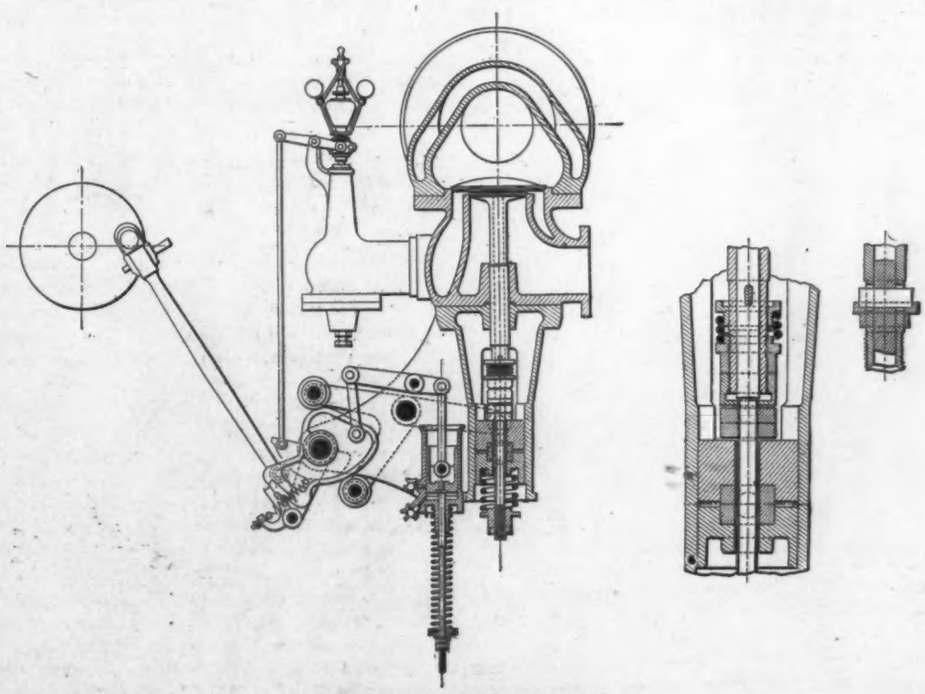


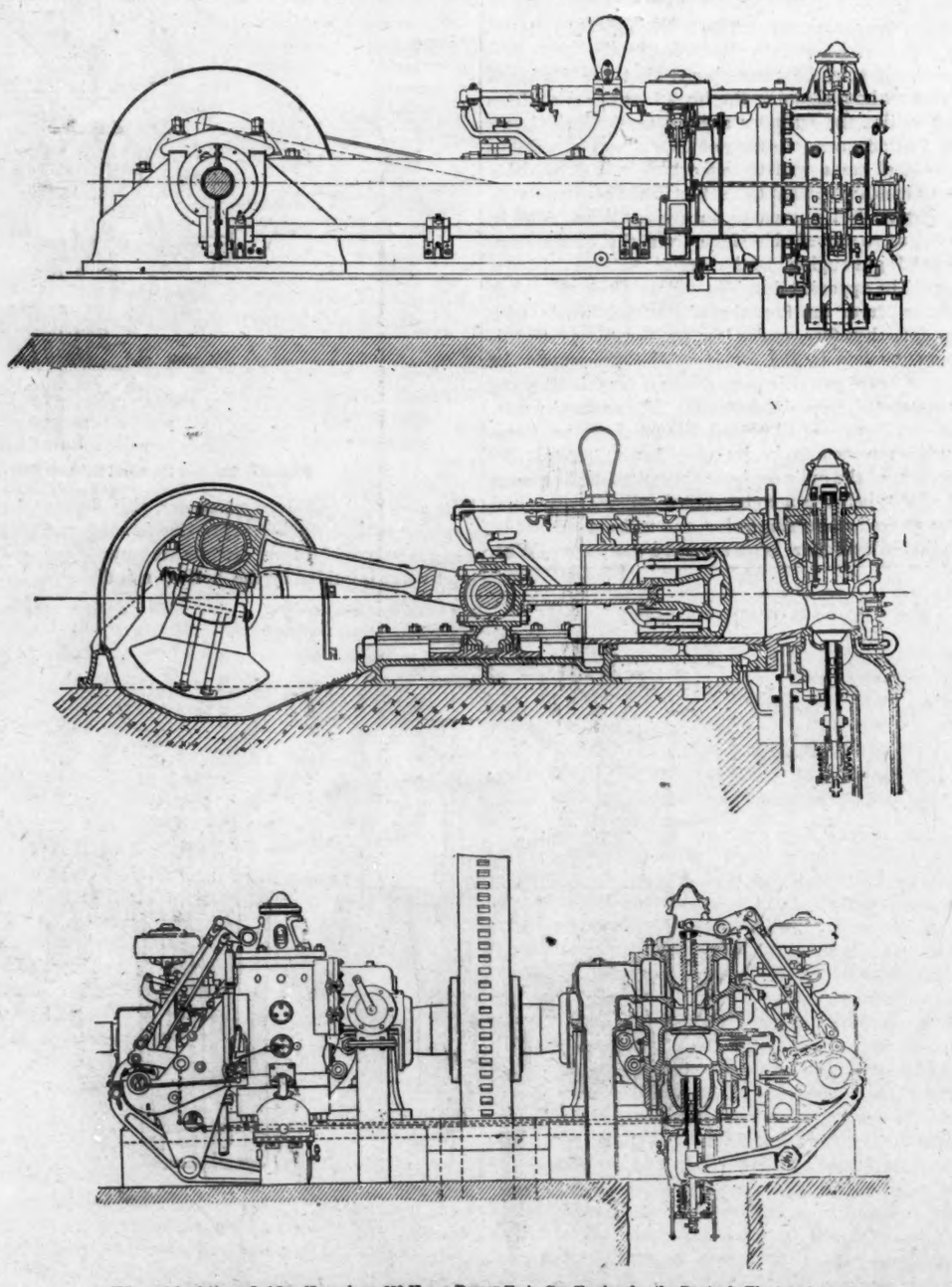
Fig. 8.—The New Cockerill Inlet Valve.

1. *Iron Age.*

Both valves are actuated by the same governing mechanism, the one valve admitting air and the other gas. The governor operates in the following manner: According to the position of the governor at the determined moment of the suction stroke a latch mechanism is released so that both valves suddenly close through the action of springs. The governing mechanism itself takes part in this sudden movement. In its principle this governing apparatus is the same as that used by the Deutz and Nuernberg Companies. The former had such a gear in operation in which the mixing valve was combined with the inlet valve direct and was served by a latch motion. This Company, however, gave up this design because the necessarily violent spring pressure yielded too much back pressure upon the governor and affected the mechanism.

In the case of the Cockerill cylinder head the exhaust valve is placed so low that surplus oil and dirt can be removed. The arrangement is such that it is rather difficult to take away the valve case, but it is possible to reach the valve through an opening for the sake of cleaning. Naturally the very large exhaust valve puts a heavy strain upon the governor shaft and its mechanism, so that the wheels and the journals are subject to a good deal of wear. The ignition is obtained in a spark chamber, in which electric sparks are constantly formed, through the intermediary of a slide valve, which connects this spark chamber with the cylinder at the proper moment. The period of ignition may be adjusted when the engine is to be started. The Cockerill ignition apparatus has the advantage that the sparking is not prevented by moisture accumulating in the cylinder head during times of idleness. Therefore in starting the ignition is surer. Cockerill now uses the Bosch igniting apparatus. It is only recently that the engine is started with compressed air, as is done with other motors, having been done formerly by a mixture of benzine. This arrangement is said to have refused occasionally in former times. To-day, however, the benzine evaporator, a very small apparatus compared to the engine itself, is said to have been improved so that the starting of the engine with benzine is now without a defect. The engine has no guides, the cast iron piston without any white metal lining is cooled, and both it and the cylinder are provided with oil grooves. Ever since the firm of Cockerill have substituted a cast iron frame for the well-known rod connection between the cylinder and the pillow block the engine has a thoroughly solid and strong look. With their ordinary 4-cycle design arranged as a double tandem engine Cockerill reaches a maximum power of 2,400-horse power, which is doubled in the case of the double acting 4-cycle motors to be described further on.

Nuernberg.—The Maschinenbau Gesellschaft Nuernberg has preferred the tandem arrangement for larger powers. At the present time a



Figs. 10, 11 and 12.—Nuernberg 350-Horse Power Twin Gas Engine for the Rostock Electrical Station.

750-horse power single cylinder machine is being put up at the Rheinische Stahlwerke at Meiderich. This is probably the largest 4-cycle cylinder engine thus far constructed. The designs of this famous firm of steam engine builders show the tendency to equip the gas engine with all those arrangements which have proven satisfactory in the case of the steam engine. Above all, this applies to the special guides.

Originally the Nuernberg engine was so arranged that the piston prolonged forward bore the cross head pin, and that this cross head was guided in round guides. This in itself was not a particularly good method of guiding, but it was an improvement, and above all brought the piston pin outside of the hot zone. Now Nuernberg build even 4-cycle engines of 200 and 250-horse power with complete guides, as may be observed from the accompanying figures, 10 to 12, showing an engine built for the electric station at Rostock.

The Nuernberg engine inspires a good deal of confidence through its heavy frame, upon which the cylinders are bolted. It is true that in the tandem engine the front cylinder head seems difficult to get at so far as the exhaust valves and their gear are concerned. This, however, is not usually of much consequence, since the exhaust valves may be reached from above.

The cylinder head is constructed in a peculiar manner and consists of several sets, one of them being the main part, a steel casting screwed on by means of a flange, and the other pieces screwed on from above, as shown in Fig. 13. By this subdivision the principal part becomes a simple casting. In consideration of the tandem arrangement, or rather of the piston rod which passes through, the cylinder head at the larger engines is so arranged that an inlet valve is placed at both sides of the piston rod, while one of the exhaust valves is located underneath each of them. The middle piece is so high that the valve cases, which are ground in, extend above and below. This design had evidently been so chosen in order that the inner wall is only partially exposed to the high temperature, and is cooled both from within and from without at its upper and lower ends. The strains upon the outer and inner wall are therefore reduced to a minimum in this part of the engine. On the other hand, the flange and the relatively thin outer wall of the cooling jacket offer little security. I do not believe in stiffening the flange and the outer wall by ribs, as I have seen done in the case of several cylinder heads. The makers advise me that none of the heads of this design has yet cracked, and that they have improved the same even further in their latest engines. The question naturally arises how long those heads which have not yet cracked have been in active service. The employment of 4 valves, of course, makes the cylinder head and the gear somewhat complicated. It has the advantage, however, that the exhaust valves may be made to lift one after the other, thus reducing the shocks upon the gear shaft. The exhaust valve cases are difficult to manage so far as the effect of high heats are concerned. The Nuernberg design, however, has provisions for effective cooling. The governing is carried out in different ways by the Nuernberg Company. In the large

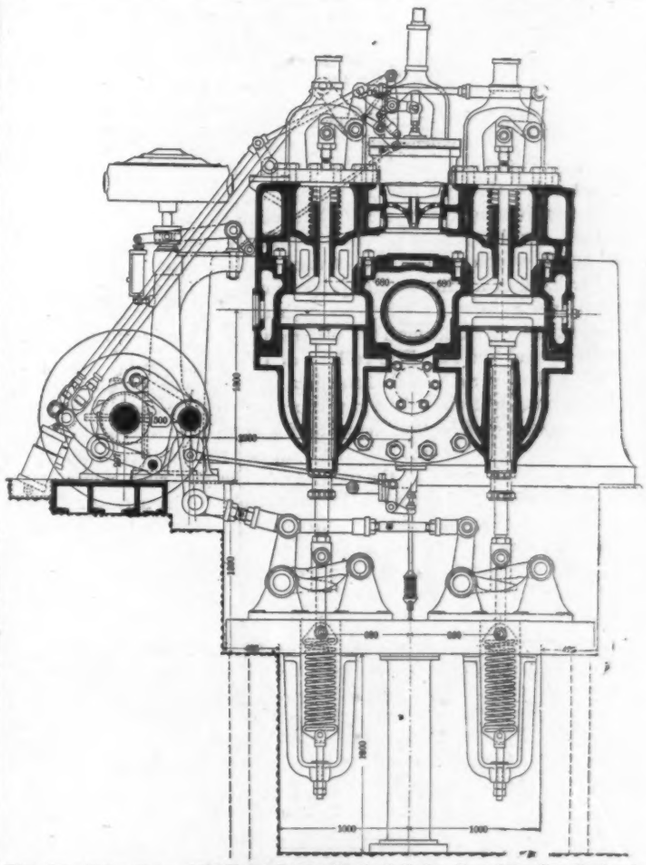


Fig. 13.—Valve Gear of 750-Horse Power Single Cylinder Nuernberg Gas Engine for Rheinische Stahlwerke.

750-horse power single cylinder engine the governor operates with the aid of a latch motion in a manner similar to that of many steam engines actuating a nearly counterbalanced double seat valve with air slide. The valve is lifted up by the gear rods, opening two separate ports for gas and for air in the same proportion and closing them rapidly. The design is shown in Fig. 13.

This valve is very light and is placed at a fifth valve in the upper part and is connected through short ports with both inlet valves. The latter are actuated by cams in such a way that they are open during the entire suction stroke. The mixing valve has closed before, the time being de-

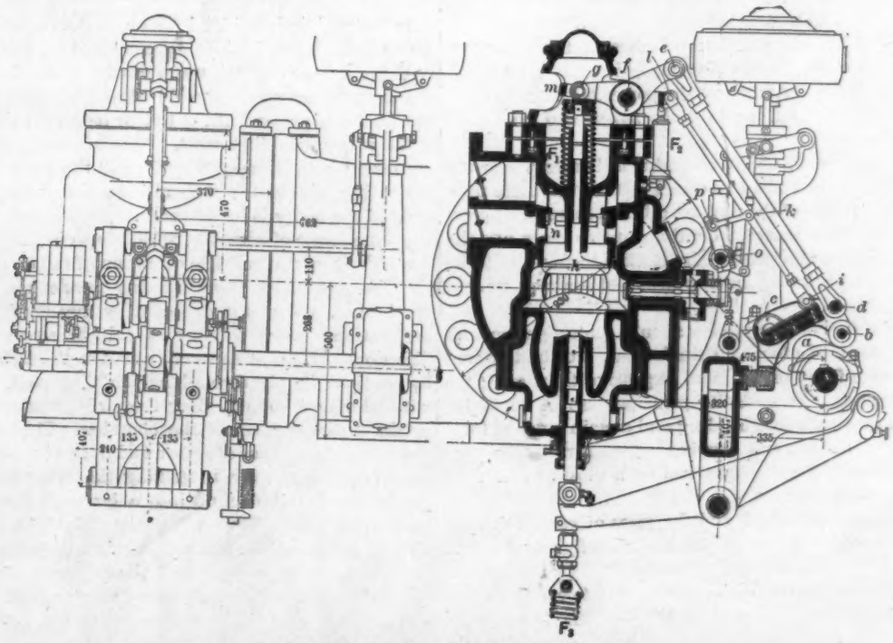


Fig. 14.—The New Gear of the Nuernberg Company.

termined by the position of the governor, and the gas mixture under the mixing valve expands up to the end of the stroke with the inlet valve. The governing, therefore, is done by quantity with constant mixture and variable compression, which processes have the advantages already alluded to.

The very latest valve gear of the Nuernberg Company is shown in Fig. 14. From the governor shaft a pressure rod *d e* is guided through the intervention of a lever *c b* and a cam *a*. The rod *d e* operates upon the inlet valve through the intermediary of a lever *e f g*. This valve opens inward during the whole of the suction stroke. It is closed by a spring *F*. In the same valve cases is a nearly counterbalanced double seated valve, which permits the entrance on the one hand of gas and on the other hand of air in constant proportions. It is pressed downward through two spindles attached on both sides of the spring *F*. The movement is secured through the intermediary of the forked lever *m f l* and the second rod *l i*. The roller *i* of this rod is in contact with a surface on the lever *c b*, so that the mixing valve is also opened during the entire suction stroke. The governor itself acts by displacing the rod *l i* by moving it on *l*, so that the roller *i* is more or less distant from the fulcrum *c* of the lever *c b*. In this manner the mixing valve opens more or less, according to the position of the governor, while at the same time the inlet valve makes the same stroke. The spring *F'* closes the mixing valve and keeps the rod in tension. This method of governing depends upon regulating the quantity and in its arrangements and operations corresponds closely to that of the Deutz Company. It seems to me, however, that the Nuernberg design deserves the preference, because the strain upon the governor is smaller. For all motors of 150-horse power and upward the Nuernberg Company cool the piston and the particular method of supplying the water is patented to the firm.

Like in the case of other motors with guides, the removal of the piston is very simple without disconnecting the connecting rod or the cross head. The Maschinenbau Gesellschaft Nuernberg now recommend double-acting 4-cycle motors for large powers, but have not yet exhibited these latest designs.

[To be Continued.]

The Use of Fuel Oil in Chicago.

A correspondent of *Engineernig and Mining Journal*, writing on the topic named in the heading, says that a recent careful investigation made to determine the truth of some rather vague statements made as to the growing use of oil fuel shows that there is very little oil used in Chicago. Ten years ago the Illinois Steel Company used it extensively, consuming 7,000 to 10,000 barrels a day. At present this concern does not use more than 500 barrels a day, in its Joliet plant. Oil was found too expensive, as compared with the gas manufactured by the Company for its own use. At Joliet they do not use any gas.

There is probably no concern in Chicago that uses more than 500 barrels a day, or indeed so much. One of the heaviest users is the Chicago Union Traction Company, which operates street cars on the west and north sides of the city. In some of the power houses of this Company oil is found advantageous because of its convenience in getting up steam quickly for intermittent power. At most of the power houses, however, coal is used and the oil burners will probably be superseded with coal fire boxes in the near future.

Oil was used in a number of Chicago apartment houses five or ten years ago, but has been generally abandoned. Probably not more than 1 per cent. of the heating plants of the city use oil, and there is no prospect that the number will be increased. Until about two years ago the University of Chicago fed the products of Mr. Rockefeller's wells to its furnaces, but since the completion of the new heat and power plant coal has been used exclusively.

For most consumers of fuel oil the price is about 3 cents a gallon, and 125 gallons are equivalent to a ton of Illinois coal, worth at present about $2.75 on cars. Manifestly oil is more expensive than coal; too expensive for most purposes. It finds its principal use in 50 to 100 manufacturing establishments where bending and certain kinds of forging are done. The McCormick and Deering agricultural implement factories use it, for instance. Natural gas has been substituted for oil in a number of the apartment houses.

"The price of oil has been advanced, and the price of coal declining, of late years." That seems to express the situation briefly. All of the fuel oil sold in Chicago is furnished by the Standard Oil Company.

There has been an increase in the consumption of refined oil in Chicago city, due to the high prices of coal lately, but this is not great, probably not amounting to more than 10 to 15 per cent. increase, and is largely temporary in its nature. It will pass as the coal market resumes its normal condition.

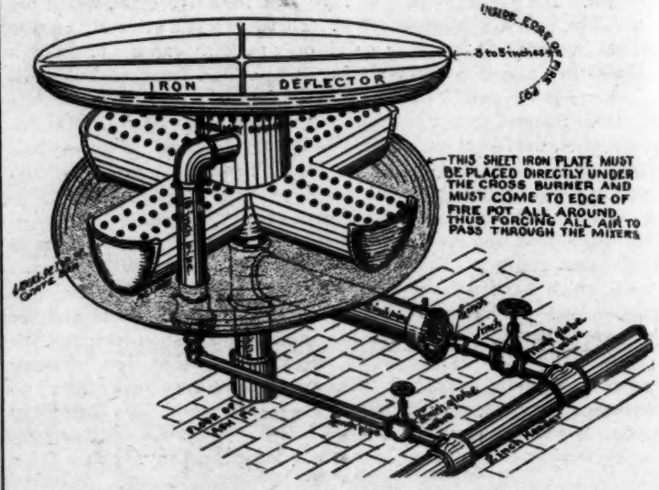
Aside from this temporary demand, parties who are in a position to know the facts estimate that not more than 1 per cent. of the fuel consumed in Chicago is oil, and the proportion is not increasing.

Some Economical Gas Burning Appliances.

By Mr. W. H. Test, Lafayette, Ind.

Gas as a domestic fuel, especially in the natural gas regions, is almost a necessity and the threatened failure has turned attention to its economical consumption. This same regard for the economical burning of artificial gas is a lively one in the larger cities, where the use of artificial gas, as every gas man knows, for cooking, etc., is rapidly extending and its use in heating furnaces shows great possibilities. The days of high pressure natural gas have passed, and we must look forward to a service pressure of from 2 to 4 ounces. Almost any kind of mixer will serve for cheap, high pressure gas, but with low pressures it becomes a serious problem to obtain the proper mixture of gas and air in the mixer and at the same time escape the danger of flashing back. The old method of placing a wire gauze at the point of ignition, or some place near it, or passing the gas and air mixture through a long narrow pipe, will prevent the flashing back, but impedes the flow of gas and impairs the efficiency of the system for producing the proper gas and air mixture.

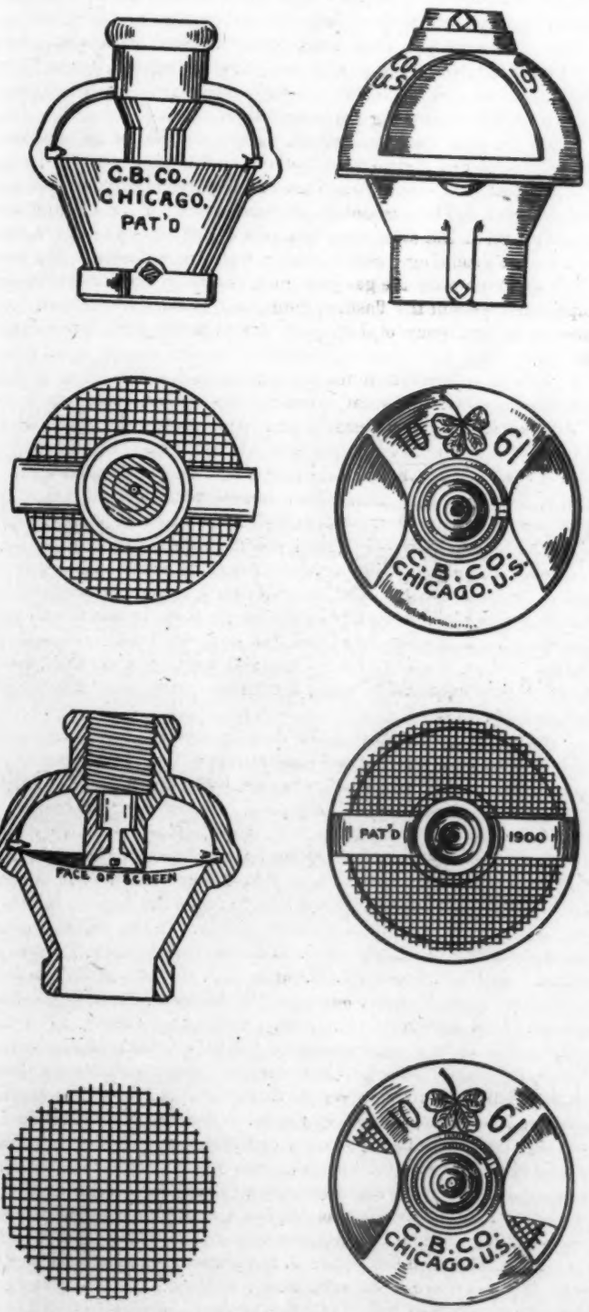
There has been in operation for the past 3 years a mixer using old ideas, but in a new and original manner. These mixers, in combination with a burner of novel design, have been used successfully with


IRON
DEFLECTOR
THIS SHEET IRON PLATE MUST BE PLACED DIRECTLY UNDER THE CROSS BURNER AND MUST COME TO EDGE OF FIRE POT ALL AROUND THUS FORCING ALL AIR TO PASS THROUGH THE MIXERS

both natural and artificial gas on pressures as low as 1 ounce and, so far as I can learn, is the only combination that will successfully burn coal gas or carburetted water gas in a hot air or hot water furnace. The new application of the old ideas is to use a wire gauze to break up the stream of gas and air, not at or near the point of ignition but at the point where they first meet. This is accomplished by placing a wire gauze across the base of the mixer at the point where both gas and air enter, thus giving the gas and air streams the effect of a spray. The body of the mixer is in the form of a truncated cone, the sides converging at an angle of about 7°, which form is well known to give the best gas and air mixtures. The operation of the mixer is thus described:

"The gas issues from the gas nozzle and strikes the perforated diaphragm, where it is deflected by means of the metal between the perforations into a number of minute streams flowing in different directions. These streams of gas strike the air before them and engage by friction the air through which they pass, carrying the air along with them and commingling therewith, being aided in such operation by the tapering form of the chamber. This action creates a partial vacuum in the mixer chamber and draws in air through the perforated diaphragm, which air, in striking the metal between the perforations is, like the gas, broken up into a large number of streams having different directions. The result of the action of the diaphragm on both the air and gas is an intimate and re-mixture thereof, so that each combustible element of the gas is in the presence of the proper quantity of oxygen to produce perfect combustion; a mixer in which the diaphragm extends only over the air entrance and not over the gas nozzle is very effective for very small mixers. The flow and the pressure of the gas

can be regulated by the gas supply valve, and the easily removable diaphragm furnishes a convenient means for regulating the supply of air, since a diaphragm having a greater or less area of openings therein can be substituted for the one which does not admit the requisite quantity of air. The mixer performs its function in a most efficient manner, at the same time offering a minimum resistance to the passage of the gas and air through it, for the gas strikes the air in such an advantageous manner that it easily produces the desired inflow of air, and the air meeting with only the resistance of the perforated diaghragm, enters so readily as to require but little pressure on the part of the gas."



As stated above, this mixer will operate efficiently on the lowest pressures encountered in artificial gas mains, and an extremely accurate regulation of the air can be obtained by fitting the base of the mixer with a suitable shutter. A mixer thus equipped gives the best results with artificial gas.

The burner used in connection with these mixers is a combination of two burners for convenience and economy in burning large or small quantities of gas. The small burner is cylindrical, the gas entering at the side and burning from a ring of small holes at the top, the flames striking against a cast iron deflector. The small burner is supported on a four-arm, cross burner, supplied with gas from the bottom, the gas burning from three rows of perforations on each arm, and the flames striking the cast iron deflector. The burners have separate mixers and valves, and the small burner will consume from 5 to 60 cubic feet of gas, and the large burner 180 cubic feet of gas an hour on a 2-ounce gas pressure from a 2-inch heater. The details of the burners and mixers are shown in the diagrams.

These appliances are the property of the Claybourne Burner Company, Chicago, Ills.

Some Notes on Illumination.

By Mr. Bassett Jones, Jr., in *Elec. Engineer.*

With all the discussion that has lately arisen over the measurement of light considered primarily from the standpoint of artificial illumination, it seems proper that some note should be taken of the various methods of lighting required under certain specific conditions.

It is, of course, obvious that with widely varying requirements there must be widely varying types of illumination, and it will be found that there is a certain type of illuminant best suited to each condition. Possibly as lying at the two opposite extremes, may be mentioned the source of light best suited to illuminate the open air freight yard, and that best suited to illuminate the book for reading.

In the first case we require the widest possible distribution of light at maximum intensity, and in the second case the softest quality of light attainable, and projected preferably in a single direction.

There is little doubt that among existing types of illuminants the arc lamp is best suited to our first condition, while for the second condition we find the green shaded oil burner justly popular.

Under all conditions of illumination the object sought is so to arrange the light source that its rays are only perceptible to the observer through their reflection from illuminated objects. This result is impossible save in a few special cases, but the nearest approach to it will be secured by making the elevation of the source such that its rays do not shine directly or horizontally into the eyes, and this requirement applies equally to outdoor and indoor lighting.

Where the area to be illuminated is extensive the units of light should be so distributed as to give the most even illumination compatible with first cost and maintenance of equipment. Bright spots, as well as dark zones, should be as far as possible eliminated, and where, as in the case of the arc lamp, the body of the fixture casts a shadow directly below, the arrangement of lights should be such that one lamp throws light directly under neighboring lamps.

The great difficulty with the arc lamp is that its maximum rays are inclined toward the horizontal, and this, while widening the area of illumination, produces decidedly uncomfortable effects on the eyes, and often by its very intensity prevents the observer from seeing the objects illuminated. This drawback has been in some measure eliminated by the use of the inclosed arc, using ground glass or diffusing globes, but even here the high intrinsic brilliancy necessary to an efficient illumination over a considerable area, still leaves the subject in an unsatisfactory stage of development.

Where inclosed arcs with clear globes are used, the marked unevenness of the illumination is decidedly detrimental. It may be overcome to some extent by bringing the lamps fairly close together, so that the portions of the surface left dark by one lamp may receive the maximum value of illumination due to a neighboring lamp. Except in certain special cases such an arrangement would produce an extremely wasteful brilliancy, and would be far too expensive for consideration.

The fact still remains that the arc lamp as at present used for outdoor illumination is unsatisfactory from every point of view, but until an ideal substitute is devised, with its maximum intensity thrown at the widest angle and equally grading off to a vertical illumination suitable for the height at which the lamp is hung, we must be satisfied to stumble along our streets in alternate brilliancy and darkness.

At present the tendency seems to be toward horizontal arcs, but here the vertical rays are the strongest, and diffused light must be obtained by the use of ground globes with consequent decrease of efficiency from the standpoint of light actually received. The flame arc appears to produce very satisfactory results and will doubtless become a hard competitor of the pencil arc, so soon as its complicated mechanism has been simplified.

By suspending the horizontal or flame arc at a considerable height it is possible to extend the radius of illumination, but only at the cost of intensity according to the laws of inverse squares.

As a rule, the value of the intensity of illumination is the first consideration only in outside lighting. In this case the maximum value of light that can be obtained and spread over a given area per unit of

energy expended is the guiding factor. As we have mentioned, for the lighting of large areas from a few centers of illumination the vertical arc without doubt best satisfies the condition.

For street lighting, where the value of the light obtained is sufficient to warrant the use of numerous sources of light in fairly close proximity to one another, and where the traffic is sufficiently heavy, a source of light throwing its rays downward and at the same time diffused toward the horizontal, is much to be desired. Even if such a lamp does not show as high efficiency rated in mean spherical candle power as is shown by the vertical arc lamp, its effective illuminating power—its value as an illuminant of the roadbed—will make its use advisable over all other forms of light source.

As a matter of fact, there are on the market to-day two or more lamps that satisfy these conditions in a greater or lesser degree, and have the advantage of efficiency nearly if not equal to that of the open arc. Unfortunately, they are still more or less in an experimental stage, although the Nernst lamp has, we may say, become an established fact, and has even been applied to street lighting.

On the other hand, for country roads, and in streets where the traffic is light and where the effective value of illumination is of small consequence, we are justified in using the lamp that will give the maximum intensity of illumination per unit of energy expended, and will spread its light over a maximum area. The quality of light emitted is now a minor consideration.

Thus, while a vertical arc lamp throws a dark spot directly beneath, yet the total area illuminated sufficiently for ordinary purposes is far greater than the lamp throwing its maximum intensity of light in a vertical direction.

When we consider interior illumination we find that the conditions vary in an infinite number of ways. Usually no actual formulæ are applicable for the very strong reason that the taste and needs of the occupants of the room or building vary in most extraordinary and unexpected forms. The success of the lighting system must depend practically entirely on the judgment of its designer and on his ability to see things through his client's eyes. Private house lighting is particularly variegated in this respect, and often a dozen different types of illumination are required within the four walls of one building.

In the lighting of halls and auditoriums and inclosed spaces of large extent the same considerations that apply to outdoor illumination will, in a great measure, determine the system installed. Sometimes, sad to relate, first cost is the first consideration, and consequently the light-giving source must be centralized.

Whatever the type of light adopted, it is imperative to supply the general light from a source overhead, and no light-giving sources should be permitted to throw rays directly into the users' eyes.

Wall brackets, for instance, should be used only for purposes of decoration—exceptions being taken in the case of bureau and dressing table lights. The light from wall brackets should be killed by the use of colored shades or globes. Table fixtures similarly should be supplied with colored shades that will reflect the light so as to confine it within the surface of a cone, no part of which reaches to the users' eyes.

From a decorative standpoint center chandeliers give the most effective "style" to room illumination. Even here the drop of the fixture should not be great enough to disturb the eyes with horizontal rays. The light units employed should be as far as possible small and numerous enough to give a hemispherical form of light source with the flat upwards. Design of fixture and quality of illumination may clash, but the result should tend along the lines indicated.

For the best quality of evenly diffused light single small power lamps studded in the ceiling give a most equally distributed illumination, but is to be criticized from the standpoint of light and shadow, A room without contrast is a most uninteresting and uncozy affair.

It is readily seen from the above consideration that in most cases the "watts per candle," or the mean spherical candle power, has little to do with the value of the lamp as an illuminant. The principal factor in selection of the lamp is its suitability for the case considered. Circumstances are frequently arising where a number of low candle power lamps are used in preference to a few units of higher light giving power, although the former are more costly in both power and maintenance.

It seems peculiar that while an 8-candle power lamp used frequently if necessary, will give so much better a type of illumination, yet all our energies have been expended in increasing the efficiency of the 16-candle power lamp—a unit too powerful for all uses but that of general illumination.

Of course, it is the duty of the engineer to see that his client gets the most efficient lamp suited to his requirements, but the effective illumination desired must be the first consideration.

High Pressure Steam Piping.

In a paper read by Mr. William Andrews at the last meeting of the Engine Builders' Association of the United States, the author said:

The art of piping for high pressure steam is of legal age. Twenty-one years ago, when Edison, at Menlo Park, brought out his electric lamp and called upon the engine builders, boiler makers and steam fitters to assist him with better apparatus, 80 pounds steam pressure per square inch on the boiler was considered good practice. It is true that higher pressures had been used on steamboats and locomotives, but the majority of stationary engines used in factories and mills were slow speed engines, piped with ordinary merchant pipe and screwed fittings, put up by anyone who could use pipe tools. Soon all this was changed for the better, high speed engines were introduced, pressures were raised, fittings and valves were made much heavier and put up with some regard to expansion and contraction.

About the year 1890 high speed, compound non-condensing engines were installed in the central station of the Edison Electrical Illuminating Company, of Brooklyn. This was the first prominent installation of engines of this type and the specifications called for a steam pressure of 150 pounds. The pipe specifications called for flanged fittings and full weight special pipe, all to stand a working pressure of 150 pounds. There were no patterns for such fittings among the Eastern manufacturers, and presumably, none among the Western foundries. At any rate the fittings were made to order from special patterns and they are carrying steam to-day at full pressure. In this station was introduced the "double system" of piping which became a fad for a few years, but like the American buffalo, has become extinct.

About this time copper pipe became popular for high pressure work, probably on account of the ease with which it could be bent and formed into curves, which were just coming into fashion, but after a few years of use, having proved itself a very treacherous metal, it was discarded and now is very seldom used except for expansion bends in exhaust pipes. About 1892 wrought steel piping made in the regular way had become so reliable that it was used in making bends and steam mains, and at the present time is so generally used, that if an engineer wishes wrought iron pipe, especially in the larger sizes, he has to call for it in his specifications and then wait for it to be made. Pipes, fittings, valves, pumps, engines and all material used in a modern, first-class job, are now required to stand a working pressure of 200 pounds per square inch.

Strange to say that during the development of the electric light and railroad interest, almost the entire efforts of the engineers and owners were given to improving the engines, boilers, generators, heaters and pumps to the exclusion of the piping. So far was this carried that it was no uncommon thing for the owner, after the above mentioned articles were bought, and his attention was called to the piping, to say, "Piping! Oh, don't worry about that I will let my plumber put that up." It may not be out of place here to name the engineers, who, during the dark days of high pressure piping, always called for and insisted on the best. They were: William Lee Church, Frederick Sargeant, Charles E. Emery, J. H. Vail, E. J. Cooke and J. Van Vleck.

A modern high pressure steam job requires: First, a good design; second, good material, and third, skillful steamfitters. The first requirement can be altered to suit the conditions, but the other two, never. Up to the year 1900 the almost universal design for a piping system for power plants was to carry a pipe from each boiler into a large steam header, whose cross section was equal to the sum of all the areas of the feeding pipes. If the designing engineer wanted to be very grand, he made it larger without knowing just why. From this header pipes were carried to the various engines, of sizes called for by the engine builder. It was quite common to place steam separators in each line leading to an engine, bnt fashions changed in steam piping, as well as in clothes, and with the advent of high pressure and superheated steam, sizes of pipes have been very much reduced. In the 4 large power houses now built in New York city, with an ultimate capacity of from 60,000 to 100,000-horse power each, the largest steam mains are not over 20 inches in diameter, and these are used more as equalizing pipes than storage reservoirs.

Some of our best plants have pipes which run from the header to the engine two sizes smaller than that called for by the engine builders. These pipes before reaching the engine are carried into a wrought iron or steel receiver, which acts also as a separator. This receiver has a cubical capacity of three times that of the high pressure cylinder, and is placed as near as possible to the cylinder. The pipe from the receiver to the cylinder is of full size called for by the engineer builder. The object of this arrangement is, first, to have a full supply of steam close

to the throttle; second, to provide a cushion near the engine on which the blow caused by the cut-off in the steam chest may be spent, thereby preventing vibrations from being transmitted through the piping system, and, third, to produce a steady and rapid flow of steam in one direction only, by having a small pipe leading into the receiver. This steam flows rapidly enough to make good the loss caused during the first quarter of the stroke. Plants fitted up in this way are successfully running where the drop in steam pressure is not greater than 4 pounds, although the engines are 500 feet away from the boilers. This is probably the most radical departure in high pressure work up to the present time. Allowance for contraction and expansion is provided for by long bends, by using a double swing like a gas bracket on which the fittings turn on the threads of the nipple, and by producing what may be called initial tension. This can hardly be described in words, but is a rule of thumb method by which the skilled steamfitter puts a strain on the pipes when cold, so that when the pressure is put on the expansion removes this tension and there remains no strain on the pipe, other than that due to internal pressure.

As to quality of material, in the earlier days of electric light and railroad plants, owing to the difficulty of keeping the screwed joints tight, some engineers tried flanged cast iron pipe for steam mains, but it was heavy and clumsy and sometimes cracked on account of the unequal expansion. Then came copper, and this pipe, even when reinforced with steel wire wound around it, was found to be a treacherous metal. Flanged cast steel pipe was tried, but the difficulty of obtaining this free from blow holes barred it out. At present the material used is either wrought steel or wrought iron pipe, on which the flanges are either riveted, screwed or welded. In England and on the continent they weld a light flange to the end of the pipe and face it; it is pulled together when in use by a heavy steel or cast iron flange, which had previously been slipped over the pipe very much as copper joints are made in marine piping.

In 1880 the New York Steam Company installed about 6 miles of steam mains under the streets of New York for power and heating purposes. All the joints in this pipe above 8 inches in diameter were made by expanding the pipe into recesses in the flanges, and then beating the ends of the pipe over the edges of the flanges. This was done by machinery, and was well done, and at the time was considered a great improvement over threading or riveting, but in 5 years every joint had to be taken out on account of leaks and threaded joints were substituted. These threaded joints lasted until 1895, when all the pipes were renewed with new mains having heavy wrought steel flanges welded on the pipe. These welded flanges when turned true in the lathe make the most workmanlike and perfect steam joints in use at the present time, and their cost alone prevents their general use. Corrugated copper gaskets placed inside the bolts and well pulled up will make a joint which will last as long as the fittings. When the owner's bank account is strong enough, ground joints without any gaskets are used. This makes a first-class job, but the price is all but prohibitive.

Gate valves are almost exclusively used in high pressure work, as globe valves, especially in the larger sizes, would be very clumsy, and they would also make a pocket in the pipe. If gate valves are used often enough to keep them in good order they will remain tight many years. One of the very necessary points of a first-class piping job, and one, too, which is very often overlooked, is to have extra heavy fittings on the gauge, lubricator and high pressure drip connections. A break in one of these pipes, while it may not shut the station down, would couse great inconvenience and would be a nuisance until it was fixed.

Vibrations which often accompany the installation of high speed engines in our modern buildings are many times laid to the bad foundations or the unbalanced condition of the engine. In almost all cases it is not true, the vibrations come from the bad piping, and can be and in many cases have been removed without touching the engine or foundations. There is no excuse at the present time for having a bad piping job, and yet there is a great deal of bad piping done. Should the underlying principles of good piping, namely, good design, material and workmanship, be more strictly adhered to, much less of the present piping would have to be done over a second time. The present almost universal practice of asking for competitive bids and giving the work to the lowest bidder, is responsible for this state of affairs.

MESSRS. W. S. GRAHAM, of Philadelphia, Pa., and C. E. Starr, of Camden, N. J., have applied to the authorities of Hammonton, N. J., for the right to there construct and operate a gas works. The price they propose to charge for gas is $1.35, net, $1.50, gross, and they agree to expend $30,000 in plant construction.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

A Graduate of the Educational Class Believes the Game is Worth the Candle.

AUBURN, N. Y., Dec. 16, 1902.

To the Editors AMERICAN GAS LIGHT JOURNAL:

In two numbers of the JOURNAL I have noticed criticisms in regard to the cost of conducting the work done by the Trustees of the Educational Fund, inferring that, in the judgment of the writer of these criticisms, the good accomplished by this movement was not great enough to warrant the expense. As a member of the Class from its start I would like to take exception to such views.

Twenty-eight students have finished the course since the Class started; 16 are about through; 24 have two-thirds finished, and 42 have completed one-third of the work. This would make the total work done by the Class equal to about 74 men with complete courses to their credit.

Taking $4,000 as the average expense of the Class for one year, $16,000 would be the total expense of the above work. The average expense per student to complete the course would be $200. This takes no account of men who only partially complete the work, and who must have received some advantage.

The question raised in the criticisms as to whether $200 was too much for the good that resulted or not can hardly be open to argument. There are a large number of young men in the gas business who, not having had the benefits of a college or technical education, are ambitious to advance, and realize that they must have at least the elements of the technical side of the business in order to make much headway.

These men are willing to work, but do not know what to study or where to look for information; for such the Educational Class is of great benefit. Most of them are working hard at small salaries, and can neither afford the money to buy books nor the time to read the great amount of matter that must be gone over in order to get any results without assistance and direction.

In the Class their efforts are directed to mastering the principles of physics and chemistry necessary to understand the fundamental principles of their work, and unnecessary things are cut out. The reading necessary to get up the answers brings up a great deal of useful information to the student's attention, and in such a way that he will not forget it.

This education the average gas works employee could not afford to pay for out of his salary at the time he is doing the work, and the question raised is: "Is it any advantage for gas companies to pay for this work?"

The claim has always been made that practical men with some idea of the technical side of the work were in demand in the gas business. If this is a fact, and if for $200 an office boy or meter reader can be helped to become a competent works' or street foreman, or superintendent of a company (and there is a need for such men), it seems that the cost is not excessive.

Criticisms of this kind are very harmful to a work for which it must be difficult to raise the necessary funds, and if they are not warranted they should not be made. Yours respectfully, "ONE BENEFITED."

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, Dec. 10th, 1902.

A United Institution.—Mad Mantle Makers.—The Quality of the Gas of the Future.

The event of the month has been the meetings of the Gas Institute, and of the Institution of Gas Engineers, at which it was decided to wind up these Associations, with a view of amalgamating under one title and uniting in one Institution. It is to be hoped that the advantage of combination, to which attention is prominently directed by this action, will be rendered so evident as to tend to its adoption in connection with our district societies. The overlapping involved in ten annual addresses and also in the subjects selected for papers and discussions, and the fact that a large proportion of the same is obviously of the stop gap order, has repeatedly led the careful observer to question whether the work done by our district Associations could not be effected, without loss of efficiency, by a very much less expenditure both of money and time. Out of something like 20 meetings at which possibly 50 subjects are selected for discussion, it is impossible that the whole shall be of such quality as to render it necessary and acceptable to the profession. In the matter of papers it is notably a question of

working the willing horse, and instances might be quoted of one reader appearing at three Associations in the course of a twelvemonth. It is needless to say that he could not do himself justice under such circumstances. And yet, with all this excess of writing and reading, it is easy to quote important matters that have been neglected altogether. With the details that fall to the lot of the present day gas manager, it is impossible even to carefully read the whole of the proceedings without trespassing to a greater extent than is wise upon the periods of relaxation and recreation. So that altogether there is a wasteful expenditure of forces, whether as regards the labors of the committees and executive officers, the authors of papers, the attendance at the meetings, and the general reader, who does not wish to lose any really good points, but is compelled to examine much that is trivial or superficial in order to find them. Combined action means not only a considerable saving in establishment expenses, but what is more important an economizing of intellectual strength, by substituting order and method for confusion and chaos. There is no reason why the whole of the district associations should not be united under a central authority, perhaps with a local committee of management, and that authority should exercise some control over the meetings and the order of proceedings thereat. It should even have the power of closing a particular meeting if the only reason for holding the same is that of established custom. For meetings have been held when there was really no business to be done, simply for the sake of keeping up the connection. If no adequate pabulum is forthcoming then the meeting should not be held.

The importance of the meetings above instanced is not to be gauged by the attendance. For one reason the month of November is not one at which a large gathering can, under any circumstances, be looked for, and another is that the meetings were held late on Saturday, which practically prohibits anyone not in the immediate neighborhood, or without friends in London with whom he could spend the following Sunday, from attending. Others felt that is was not worth while to lose a day at this busy season, simply over a matter of form; for it was understood there would be no opposition. Had there been anything to call for personal support, such, for instance, as a counter proposition, the attendance would have been much larger. The general feeling is so much in favor of united action as to be prepared for any reasonable sacrifice in order to obtain it. And this feeling has its origin to a great extent in the impression that, with all the plethora of addresses, papers and discussions, the present organizations fall very far short of the needs of the profession as regards educational work, research, questions of standards and other matters, and the members will look for a substantial advance on these lines, on anything as yet accomplished. On this head it may be remarked that a Committee of the American Gas Light Association, while alluding to the fact that not even 1 per cent. of the members had aided in the preparation of a form of account, expressed the opinion that a larger proportion would be prepared to find fault with it when completed. The gentleman who is out of sight while work is being done, but largely in evidence with criticism and suggestion at a period too late in the day to be of any practical use, is not unknown on this side of the Atlantic. If the long step forward is now to be made it can only be done by the adequate support of the whole brotherhood. The gentlemen who are now at the head of affairs are capable and energetic and quite prepared to deal with the question of a decisive advance. But the generals cannot take a forward step unless accompanied by the rank and file, and the Council by themselves cannot go farther than the members are prepared to follow. The operations of the next 12 months will be watched with an unusual degree of interest, and I for one shall be inclined to regard them, not so much as an indication of the personal opinions held by individual members of the Council, as of the degree to which they are experiencing that support from the members, which they undoubtedly have a right to expect.

This autumn has seen a large addition to the number of incandescent appliances on the market, with marked reductions in price. Mantles are now being offered at as low as 1s. 6d. per dozen, and a burner complete with mantle, rod and glass chimney at something less than a shilling. What is more important, some of these mantles show an increase in strength and can be squeezed nearly flat without fracture. But I am tempted to ask whether some makers of mantles have not been driven a little delirious by excess of joy at the removal of the Welsbach restrictions as evidenced by the utterly nonsensical and meaningless titles that they have adopted. There is some sense in distinctive terms like "Vivid," "Sunlight," "Guarantee," "Standard" or "Dura;" but only to-day I have been invited to purchase mantles entitled "Natco," "Permes" and "Bonbac," while a few days since I was offered the "Glasmi" mantle. When Shakespeare asked "What's in a name?" he would have drawn the line at nonsensical and meaningless words. At any rate, the intelligent purchaser is not likely to be prejudiced in favor of an invention that is not thought worthy of an appropriate designation. The manufacturers of mantles are not singular in selecting titles of this absurd character. It is getting to be a public nuisance, that apparently intelligent people do not mind how far they go into the ridiculous in order to catch the public eye. There is not much of a compliment implied to that important organ and the intelligence behind it, in the selection of titles of which the above are specimens. Apart from that, there is a decided improvement both in the quality and variety of mantles available and the trade being done in them is excellent.

All this tends to diminish the value of the photometrical test, and to enhance that of the calorimeter. Prof. Vivian Lewes, in a lecture before the Society of Arts, quoted figures to show that only about 50 per cent. of the total consumption of gas is used in flat flame burners. This estimate is a year or two behind time, and if he had said 30, or even 25 per cent., he would have been nearer to a fair average for the whole of the country. Increased attention is being directed to the need for cheaper gas, possibly lower as regards photometrical value, but not reduced to any important extent in the matter of heating power. Such a gas could be produced with the aid of unimportant modifications or additions to the present carbonizing plant at a marked reduction in cost, always bearing in mind that only the manufacturing department could be affected. The costs of distribution and establishment expenses are only indirectly influenced according to the changes that might follow such an alteration of quality. For instance, if we can by any means increase the average consumption per service or per meter we are in a fair way to reduce both these items A reduction in price, on the other hand, tends to increase them, as the quantity of gas used is merely an incidental matter, the real question being the commercial one of providing a sufficient balance of income over expenditure to admit of fair and reasonable dividends. As evidence of the prevailing tendency it may be mentioned that two of the London gas companies have now reduced their standard to 14 candles, and it may, therefore, be expected, in regard to the forthcoming session of Parliament, that the Board of Trade will not object to proposals for lower standards, and we may possibly find the calorimeter recognized as an official testing instrument. It will be a good thing for the gas industry if it can escape the toils of the photometer, which has always enjoyed a more exalted position than it really deserves. Gas engineers have had to attend to the avoidance of fines for defective photometrical value to the exclusion of other matters that are of far greater intrinsic importance. Indeed, I will even venture to say that official gas testing is a farce, because the gas company who supply an inferior article may rest assured that they are at the same time furnishing the rod for their own punishment. Users of gas engines worked at near the full power, users of delicate technical apparatus involving questions of flame temperature, even the user of gas for boiling a kettle, will soon find out if they are not being honestly dealt with, and will act according to their experiences without reference to official tests.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Messrs. H. D. Brown, John K. Hays, C. E. Long and S. V. Brown, have incorporated the Williamsport (Pa.) Gas Engine Company. The factories are to be located in Williamsport, and the capital of the Company is put at $21,000.

Mr. E. H. Palmer, of the Auburn (N. Y.) Gas Company, says that there is no likelihood of the completion of the project to supply gas to Auburn, Seneca Falls, Waterloo and Geneva from a centrally located plant. Such a decision would look the part of wisdom, even as does the present miserable rate war at Auburn look the part of unwisdom.

The determination of the authorities of Huntsville, Mo., to sell the gas plant to Messrs. Shreve and Knight, of Boonville, Mo., has been ratified by the voters. The ballot was 245 in favor; 2 against. It is more than likely that the purchasers will install an electric lighting plant.

Mr. George W. Barbehem has been appointed General Superintendent of the Gettysburg (Pa.) Gas Company.

Mr. W. J. Graham has resigned the position of Secretary to the Ottawa (Ills.) Gas Light and Coke Company. He goes to Winnipeg, Can., to engage in a real estate scheme of some magnitude. His successor in the Ottawa Company is Mr. James Moloney, the oldest son of the Mayor of Ottawa.

A correspondent in Oshkosh, Wis., forwards the following under date of the 18th inst.: "The Fox River (Wis.) Valley Gas and Electric

Company has been in existence 2 years, and since its organization it has made rapid strides in advancing and improving the lighting systems of the thriving places of Appleton, Neenah and Menasha. They have 50 miles of pipe, and all the gas used to light the above three cities is manufactured in Appleton. The Neenah electric plant is run by gas engines. The officers and members of the Company are all gentlemen well and favorably known in Wisconsin, some of them having other large interests in the State. They are: President, T. A. Rockwell; Vice-President, H. C. Wood; Secretary, Thomas C. Clark; Treasurer, J. H. Jenkins. Since securing control of the plant many improvements have been made, and a specialty of 'fitting up' residences with gas ranges has been one of the main features, the result of which is that many residences in those cities now have excellent gas ranges, which are a great help to the ever busy housewife. A majority of the commercial and residence houses of those cities are now also being lighted by this Company, all of which is due to the good light and excellent service the citizens are given. There is, perhaps, no city in the State being better taken care of in the way of light than any of the three mentioned. There is no effort being overlooked by this Company that will add to the interests of Appleton, Neenah and Menasha, and it is fortunate that such good and true business men are at the head of the Fox River Valley Gas and Electric Company."

MR. M. G. HILL has resigned from the service of the Marquette (Mich.) Gas Light Company, the resignation to take effect next Thursday. He was its Secretary and Superintendent for a fairly lengthy term.

THE output of the Essex and Hudson Gas Company, of New Jersey, is showing a tremendous increase. In fact, it is stated on reliable authority that the sendout for the current twelvemonth will exceed 2,000,000,000 cubic feet.

SUPT. Z. M. JENKS reports that the Woonsocket (R. I.) Company, over the fortunes of which he has carefully and successfully watched for many years, has reached the limit of its generating capacity.

MR. ELMER C. RUNYAN has been appointed United States Inspector of Gas and Meters for the District of Columbia. He succeeds Dr. S. Calvert Ford, who had filled the position from the time of its making, in 1874, and who filed his resignation owing to the precarious condition of his health. Mr. Runyan, who is a native of Michigan, graduated in chemistry from the University of Michigan, and, coming to Washington, took a postgraduate course at the Columbian University, receiving the degree of Bachelor of Science. Immediately after taking this course he was appointed to a position in the Bureau of Chemistry of the Department of Agriculture, with which he has now been connected for the past 10 years. At present Mr. Runyan is chief of a division in the bureau.

THE Consolidated Gas Company, of Baltimore, Md., has appealed from the decision of Collector of Customs Stone, who assessed the duty of 67 cents per ton on the 14,000 tons of Welsh anthracite coal imported by the Company last fall. Analysis of the coal showed less than 92 per cent. of fixed carbon and made the imposition of the duty necessary. At some other ports, however, the coal was admitted without analysis. It is also the intention of the Company to join with importers of Welsh coal at other ports and petition Congress to refund the amount paid in duty.

ADVICES from Buffalo, N. Y., dated December 21, relating to gas affairs at Tonawanda (N. Y.) and vicinity are to this effect: "The Niagara Light, Heat and Power Company, of which John T. Fisher, of Buffalo, was President and Attorney, and Frederick Wende, also of Buffalo, was Secretary and Treasurer, has changed hands. Mason, Lewis & Company, of Boston and Chicago, are the new owners. The change in the ownership of the local supply of natural and illuminating gas was announced by L. T. Palmer, Manager for Mason, Lewis & Company, who returned to-day from a conference with the members of his firm. None of the members of the old Company will be associated with the new concern in any manner. Mason, Lewis & Company will begin business in the Tonawandas with a paid up capital of $250,000. With this amount they will be able to make extensive and needed improvements in the plant and service. C. H Evans, of Chicago, the Company's engineer, will arrive here next week and, with Mr. Palmer, will lay out the plans for the improvements to be made in the spring at an expense of $150,000."

THE Township Council of Stamford, Ont., has revoked the franchise granted about 18 months ago to the Lundy's LaneWater, Gas and Electric Light Company, giving its projectors the exclusive right to supply gas, electricity and water to the residents of Lundy's Lane.

JUDGE W. T. NEWMAN, of the United States Court, has signed a decree foreclosing a mortgage on the Rome (Ga.) Gas Light Company, and orders that the property be sold at auction. The restriction is made that no bid less than $25,000 shall be entertained. Mr. C. E. Mattox, of Cincinnati, O., was appointed commissioner to sell the property. The petition in the foreclosure proceedings was filed by the Central Trust and Safe Deposit Company, of Cincinnati.

"F. L. R.," FORWARDS the following from Bridgeport, Conn., under date of the 23d inst.: "The Bridgeport Gas Light Company has petitioned the next General Assembly for permission to lay its pipes in the outlying towns of Fairfield and Stratford for the purpose of supplying gas for lighting, heating and power. It has also petitioned for the granting of power to the towns mentioned to raise money by taxation to pay for gas supplied to public buildings in either of them. Southport is, of course, included in the town of Fairfield. The petition is dated December 16, and, in accordance with the law, the petitioners appeared before a judge of the Superior Court and had an order issued citing before the General Assembly, on January 8, all who might be opposed to the granting of the franchise. No opposition is expected, however.

NOTICE has been given that the hearings on the appraisal of the plants of the Norwich (Conn.) Gas and Electric Company, to be purchased by the city of Norwich, before Commissioners Henry C. White, Charles S. Mersick, of New Haven, and John M. Holcombe, of Hartford, would be commenced on Monday, January 5. This date has been decided upon by agreement between the Commissioners and the counsel (F. T. Brown) for the Company and Corporation Counsel J. T. Fanning and Gardiner Greene for the city.

THE proposition to establish a gas plant at Rochester, N. H., is still being considered. At the annual meeting of those interested in the project, Messrs. John W. Quinlan, S. D. Wentworth, A. W. Hayes and J. B. Stevens, were appointed a committee to consider the best system of gas making for Rochester, their findings to be reported at a meeting called for March 1, 1903.

THE Citizens Gas and Power Company, of Seattle, Wash., reports that its gas plant has been completed, and is now in operation in accordance with the franchise bestowed upon it. The Company has put down 20 miles of mains, and its generating plant is equal to a daily output of 1½ millions cubic feet.

THE Council of Marcus Hook, Pa., has authorized the Suburban Gas Company, of Philadelphia, to supply the residents of that district with gas for a period of 25 years. It is stipulated that the initial selling rate shall be $1.25 per 1,000 cubic feet, with a reduction of 5 cents per 1,000 for each successive year, until the rate shall be $1, which figure is to prevail for the remaining years of the grant.

THE *Journal of Gas Lighting* reports that on November 22d the Chichester (England) City Magistrates were asked to inflict an exemplary sentence upon William Bailey for committing a breach of contract as a servant of the Chichester Gas Company. Mr. J. A. Morris Bew appeared in support of the summons. The defendant was until lately a laborer and stoker employed at the gas works; and on Tuesday, the 4th ult., he was told to go home at midday and prepare to come on at a quarter to six in the evening to take his turn for the night shift with three other stokers. He left the works for the purpose, but did not return according to instructions; and a son of Mr. Church, the Company's Engineer, eventually found him drinking in a public house. He declined to come to work, and did not put in an appearance until the following Friday. In consequence of this conduct, loss and inconvenience were caused; and as it was impossible to get a stoker at a moment's notice, another workman had to be put on to give what time he could spare to fill the defendant's place. Next morning there was a shortage to the extent of 14,000 cubic feet in the gas which ought to have been manufactured; and it was pointed out that this would have a considerable effect on the pressure for the public supply. After hearing the evidence of Mr. Church and his son (Mr. Gerald Church), the Magistrates sentenced the defendant, who did not appear, to 1 month's imprisonment, with hard labor.

(*Continued on page* 954.)

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AGENTS:
New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, DECEMBER 29, 1902.

(*Continued from page* 953.)

THE Trustees of Union College, Schenectady, N. Y., have received and accepted an offer from the General Electric Company to make a gift for the equipment of the electrical laboratory and the annual payment of a sum for salaries of instructors. The course will be in charge of C. P. Steinmetz, who will hold the position of professor of electrical engineering. Mr. Steinmetz has announced that the new course will begin with the next term. One of the special plans of Mr. Steinmetz is for a special post-graduate course, which, it is expected, will be one of the most popular features of the college.

The Market for Gas Securities.

Not much trading was done in local gas securities during the week, but the recorded transactions in Consolidated were about all completed at figures somewhat in excess of the average for the previous week. The closing price to-day (Friday) was 211 to 212½. Local gas bonds continue to be in good demand.

Brooklyn Union is reported at 222 to 227. In connection with Brooklyn Union it may be noted that the local electric concerns, control or ownership of which have been offered more than once by their proprietors to the Brooklyn Union Company, are bidding for an extended lighting patronage by offering flat rate contracts at prices which look profitless, if not worse. Washington (D.C.) gas is experiencing another spurt. It is quoted at 380 to 387½. Baltimore Consolidated is unchanged. Toledo (O.) Gas Light and Coke recently sold at 128. A short-lived spurt in Bay State carried it to "2" for a minute or so. The shorts in Peoples, of Chicago, got a turn for the worse this week. It shows a gain for the week of 4 points.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.
16 WALL STREET, NEW YORK CITY.
DECEMBER 29.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$78,177,000	100	211	212½
Central Union, Bonds, 5's	3,000,000	1,000	110	112
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	350	..
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	112½	113
Northern Union, Bonds, 5's.	1,250,000	1,000	108	110
New York and East River .				
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,850	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	222	227
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	1⅝	1¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7½	10
" " Bonds, 5's	5,250,000	1,000	75	77
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	900,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	99¼	101
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,025,500	100	107½	1
Consumers, Jersey City Bonds	600,000	1,000	103	106
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	71	71¼
Mortgage, 6's	3,500,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	.	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	.	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	351,000	1,000	77	79
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	68½
" Bonds, 6's	2,650,000	..	102	105
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	75	85
Preferred	2,500,000	100	100	105
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	112	120
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	218	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	104⅛	104¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	41½	42½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	93
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	95	96½
Syracuse, N. Y.	1,975,000	100	29	..
Bonds	2,047,000	1,000	99½	100
Washington, D. C	2,600,000	20	380	387½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	..	109½	110
Wilmington, Del.	600,000	50	232	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Dec. 10, 1902.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Jan. 15th, 1903, to stockholders of record at the close of business, Dec. 31, 1902. Checks will be mailed.

1436-5 LEWIS LILLIE, Treasurer.

Situation Wanted

By a Superintendent of Many Years' Experience

In the manufacture and distribution of coal gas, laying mains and services, handling gas stove trade, repairing and setting meters, and all work pertaining to the business. Best of references.

1434-2m Address, "E. M.," care this Journal.

WANTED,

Position as Manager or Superintendent of Gas or Electric Interests.

Ten years' experience in construction, operation and management. Last 4 years in South.

1437-2 Address, "P. O. BOX 51," Jacksonvile, Fla.

Position Wanted

As Superintendent or Manager,

By a hustling young business man, who has had many years' experience in the successful management of coal, water and natural gas plants. Best of references.

1436-3 Address, "D.," care this Journal.

Wanted, Position

As General Bookkeeper with a Gas Company,

By a man of 17 years' experience. Is familiar with the McMillin system of gas accounting. Can furnish references. Please state salary paid. Address, "BOOKKEEPER,"

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WANTED,

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Experienced in drawing plans for bench construction, and remodelling and extension of a large gas plant. Apply to the

CINCINNATI GAS & ELECTRIC CO.,

1437-3 CINCINNATI, O.

WANTED,

Second-hand Station Meter, from 60 to 72 inches diameter.

Four Purifying Boxes, 9 feet by 12 feet, or about that capacity.

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In prosperous Western county seat.

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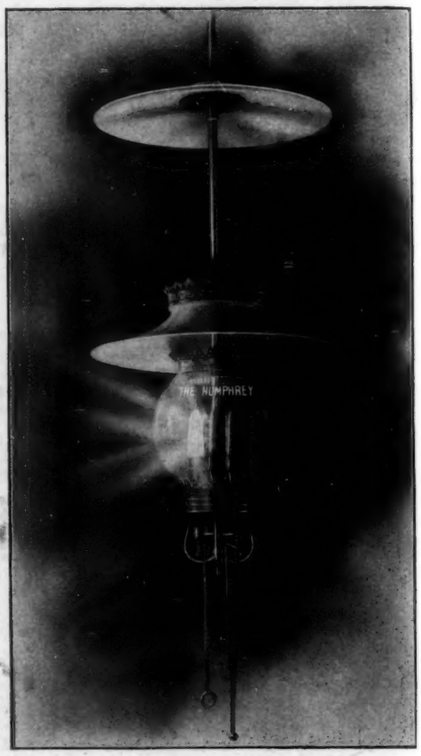
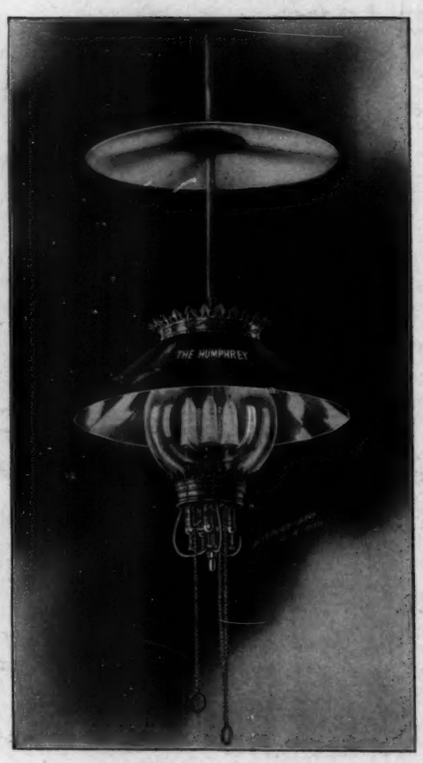
For Store Lighting with One MANTLE NIGHT LAMP.



The HUMPHREY, THE LIGHT THAT'S RIGHT.



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For Outside Lighting.

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General Gas Light Co.,

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Coal and Water Gas Apparatus, Bye-Product Machinery, Structural Work and Connections.

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Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.

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Ninety-three Illustrations and Nine Folding Plates.
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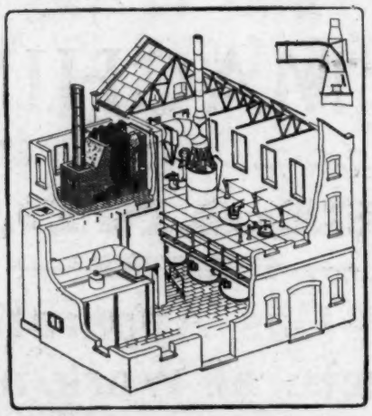
Economize Heat in Water Gas Plants,

BY UTILIZING A

Green's Economizer,



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Write for full particulars how this is accomplished, the saving effected, and the advantages gained, to the

GREEN FUEL ECONOMIZER CO.,
MATTEAWAN, N. Y.

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Coal and
Coke Wagons,
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All Specially Adapted for Use in Gas Works.

THE AKRON CULTIVATOR CO.,
MANUFACTURERS,
Akron, O.

Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

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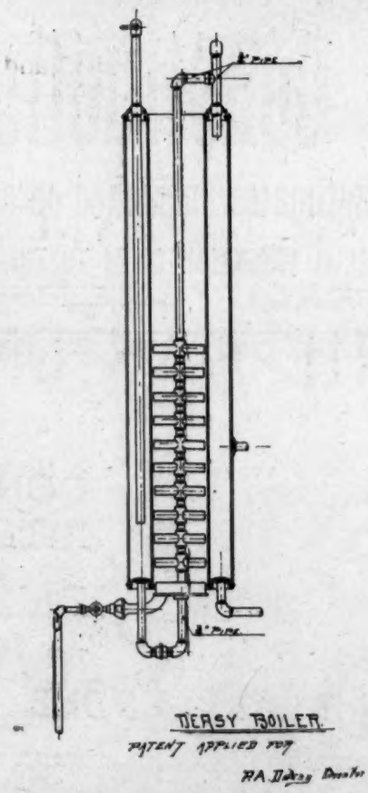
The D.M.Steward Manufacturing Co.
CHATTANOOGA, TENN.

NEW YORK 107 CHAMBERS ST. CHICAGO 57 WASHINGTON ST.

Conservation of Heat.



An Instantaneous Water Heater all Over the House.

25 gallons of water heated to 200° F. with a consumption of TWENTY feet of gas in TWENTY MINUTES.

STATE RIGHTS FOR SALE.

Deasy Water Heater Co,
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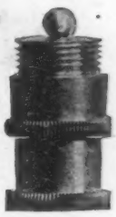
"JUST A TWIST OF THE WRIST AND YOUR LIGHT IS BRIGHT."

THE BALL CHECK.

A COMBINED GAS CHECK AND SPREADER.

The Ball Check **controls, breaks up** and **spreads** the gas at its **initial pressure.** By a twist to the right or left that **"just right"** point is **instantly** obtained for the **highest efficiency.** Nothing about it to clog up. **Fits any of the ordinary mantle burners,** makes **old** burners good as **new,** and will **light** up to **full efficiency** mantles of **any size** from **2** to **6 inches.** No **spreader** required in the **cap** of burner. Just a **plain mesh.** The **Ball spreads** the gas as it **enters** the mixing tube, making a **more thorough** mixture with the **air. No more long, unsightly mixing tubes** are necessary. The **Ball Check Bunsen tube** is **only 1½ inches long. Any candle power** up to **200** is obtainable with the **Ball Check System.** It is only a question of length of mantle. The **range of control** and **adjustment** of the Ball Check is so **complete** and **perfect** that **any** old burner will do with **this** combined check and spreader.

See that Ball?



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Patents pending in England, France, Germany, Canada, Spain, Italy, Russia, Portugal, Belgium, Japan, Brazil, Austria, Cuba, The Australias.

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Discharge in cubic feet per hour at atmospheric pressure $= 33.3 \sqrt{\frac{d^5 \times (p_1^2 - p_2^2)}{L \times w}}$

Where

d = diameter of pipe in inches,

p_1 = absolute initial pressure in pounds per square inch,

p_2 = absolute terminal pressure in pounds per square inch,

L = length of pipe in miles,

w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;

(2.) Bring the DIFFERENCE of the initial and terminal gauge pressures opposite the SUM of the initial and terminal gauge pressures;

(3.) Opposite any diameter of pipe will now be found the discharge in cubic feet per hour at atmospheric pressure; and

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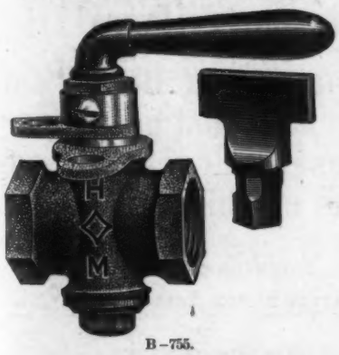

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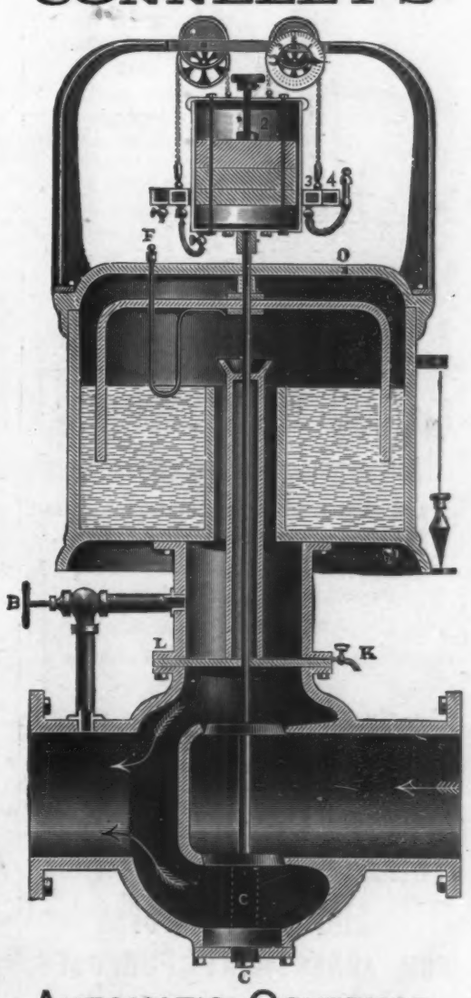

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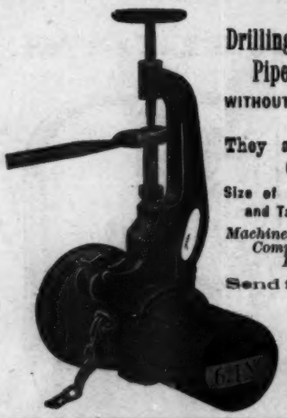

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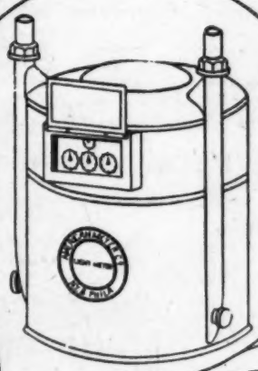

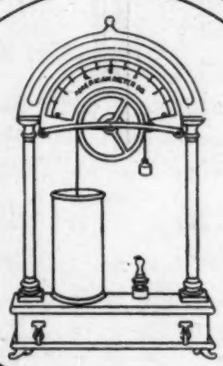

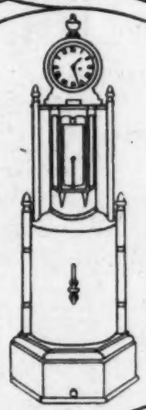

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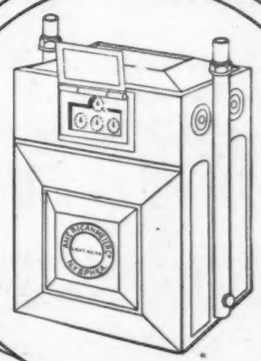
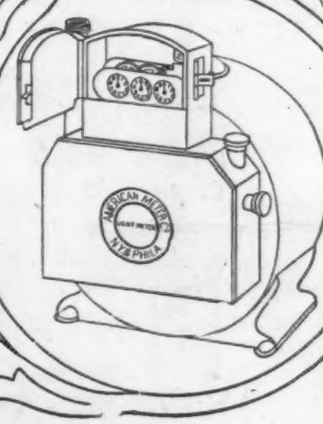




PUBLIC LIGHTING TABLE.

JANUARY, 1903.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Thu.	1	5.10 PM	6.20 AM	4.30	6.30
Fri.	2	5.10	6.20	4.30	6.30
Sat.	3	8.30	6.20	4.30	6.30
Sun.	4	9.30	6.20	4.30	6.30
Mon.	5	10.30	6.20	4.30	6.30
Tue.	6	11.40 FQ	6.20	4.30	6.30
Wed.	7	12.40 AM	6.20	4.30	6.30
Thu.	8	1.50	6.20	4.40	6.30
Fri.	9	2.50	6.20	4.40	6.30
Sat.	10	4.00	6.20	4.40	6.30
Sun.	11	5.00	6.20	4.40	6.30
Mon.	12	No L.	No L.	4.40	6.30
Tue.	13	No L. PM	No L.	4.40	6.30
Wed.	14	No L.	No L.	4.40	6.30
Thu.	15	5.30 PM	8.50 PM	4.50	6.25
Fri.	16	5.30	10.00	4.50	6.25
Sat.	17	5.30	11.10	4.50	6.25
Sun.	18	5.30	12.10 AM	4.50	6.25
Mon.	19	5.30	1.10	4.50	6.25
Tue.	20	5.30 LQ	2.10	4.50	6.25
Wed.	21	5 30	3.10	4.50	6.25
Thu.	22	5.30	4.10	5.00	6.25
Fri.	23	5.30	5.00	5.00	6.25
Sat.	24	5.30	5.50	5.00	6.25
Sun.	25	5.40	6.10	5.00	6.25
Mon.	26	5.40	6.10	5.00	6.25
Tue.	27	5.40	6.10	5.00	6.25
Wed.	28	5.40 NM	6.10	5.00	6.25
Thu.	29	5.40	6.10	5.05	6.15
Fri.	30	5.40	6.10	5.05	6.15
Sat.	31	5.40	6.10	5.05	6.15

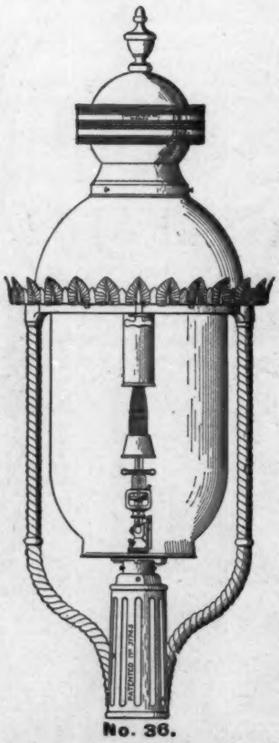
TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

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POINTS OF MERIT:

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IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

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The Welsbach Gas Arc for Indoor Lighting.

The cut tells the story—but not all of it. Get one lamp and light it—then the tale's told from beginning to end. For one Welsbach Gas Arc Lamp is a better salesman than 20 pages of advertising.

Here's what it would show if you give it a chance to prove its worth:

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Let us send you one lamp—doesn't cost a fortune—and it will answer every question you put to it; make good on every test given it. You know the only proof of the pudding? What's the use in a fellow telling you it tastes good? Taste it yourself, then you know.

May we Send you ONE Lamp?

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LOWE WATER GAS APPARATUS.

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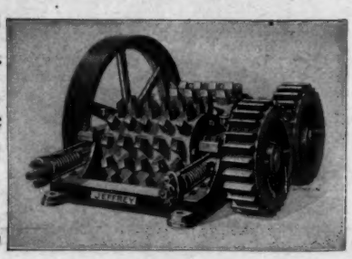

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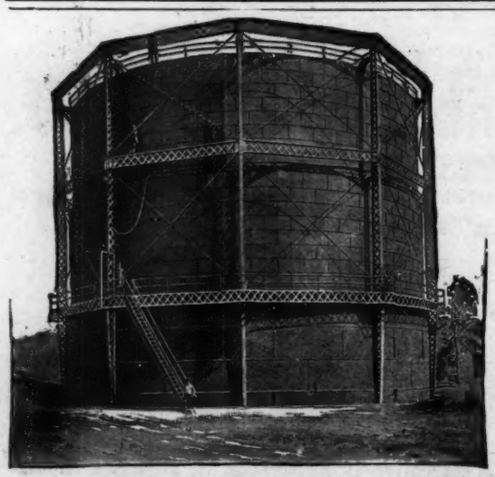

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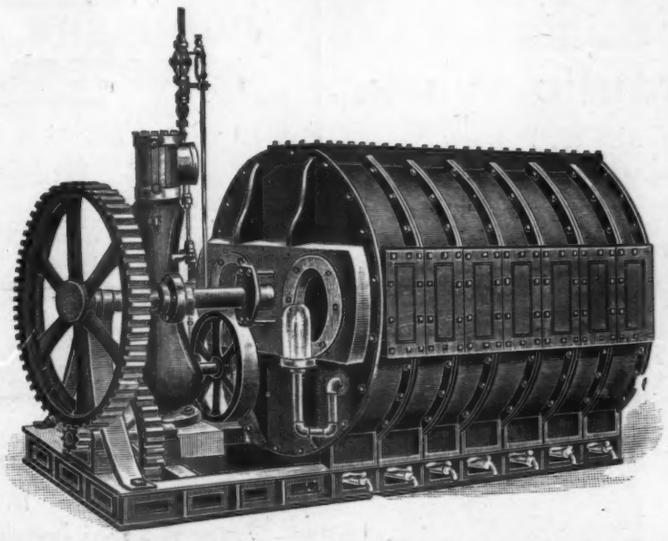

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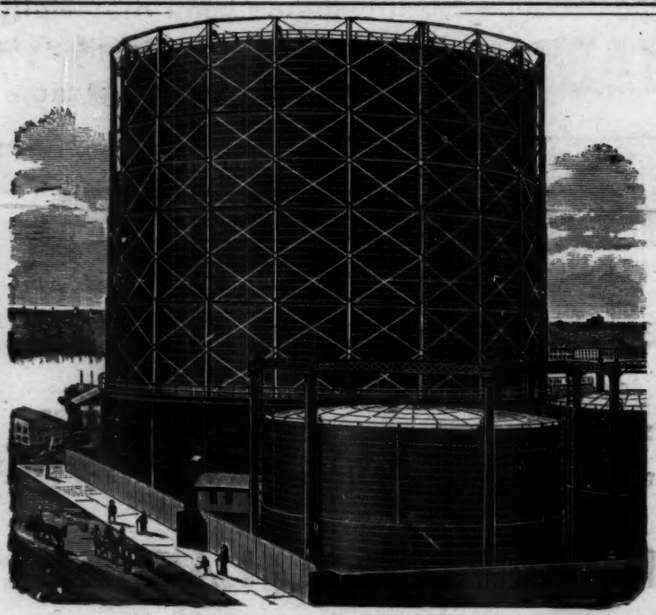

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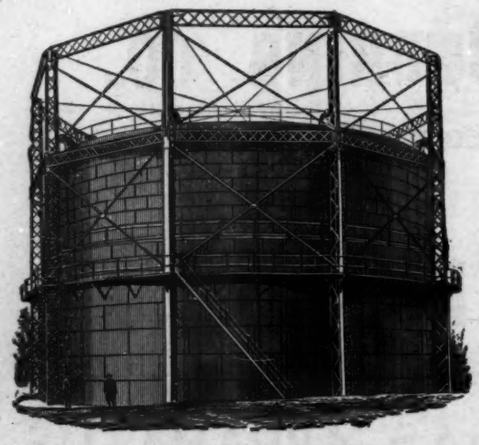

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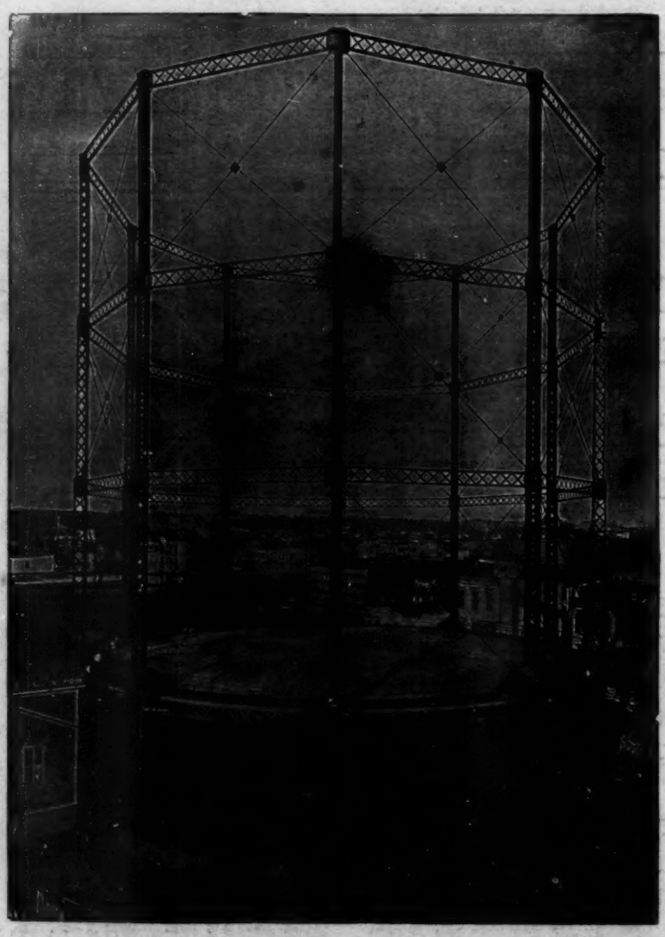

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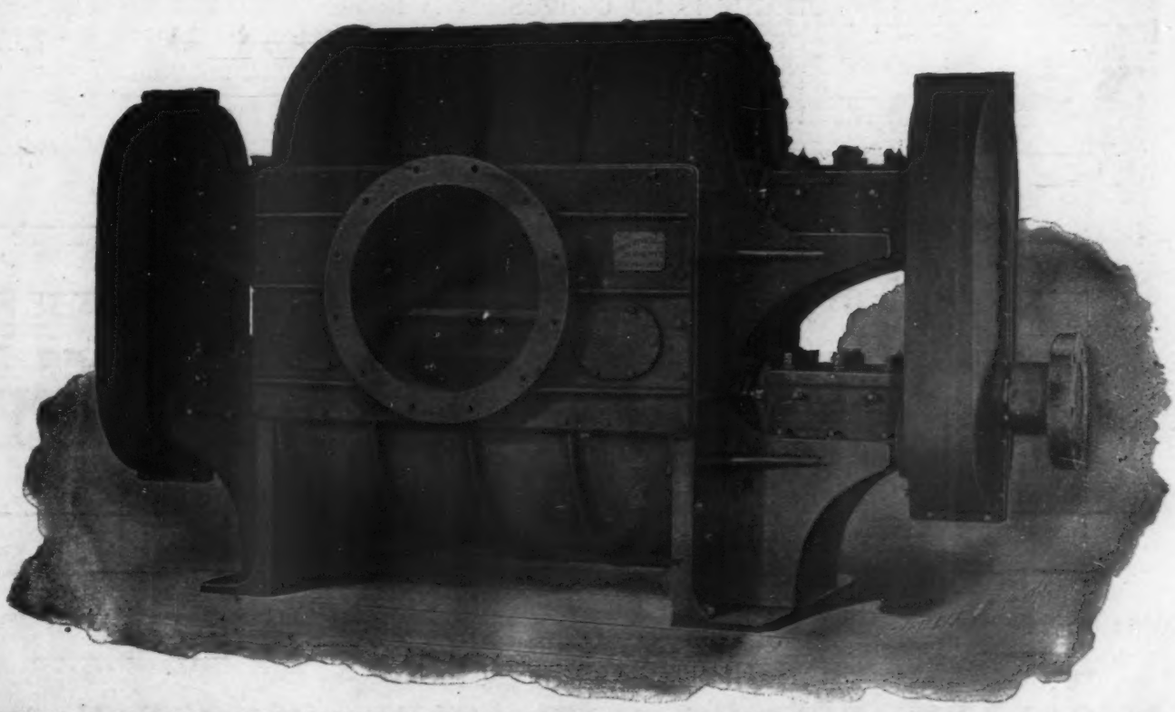

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